Volume I February, 1908 No. 4

# ANNALS
OF
# TROPICAL MEDICINE AND PARASITOLOGY

ISSUED BY

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE

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# NOTICE

Regarding the Courses of Instruction proposed to be given by the Liverpool School of Tropical Medicine, and the Examinations for the Diploma of Tropical Medicine arranged to be held by the University of Liverpool during 1908 (subject to such alteration as may hereinafter be decided upon),

Lent Term begins January 14.
Lent Examination, March 23.
Summer Term begins May 1.
Summer Examination, July 13.
Autumn Term begins October 1.
Autumn Examination, December 14.

The full Course of Instruction is open to all qualified medical men, and the examination to all students who have taken out this full course.

Fee for the full Course of Instruction—Ten guineas.

Fee for the Examination—Five guineas.

Fee for the use of a School microscope during one term—Ten shillings.

For prospectus and further information, application should be made to the Dean of the Medical Faculty, University of Liverpool.

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The following have obtained the Diploma in Tropical Medicine of the University of Liverpool:—

*Diploma in Tropical Medicine*

| *Date of Diploma* | |
|---|---|
| 1906 | Adie, Joseph Rosamond |
| 1907 | Allan, Alexander Smith |
| 1907 | Allwood, James Aldred |
| 1905 | Anderson, Catherine Elmslie |
| 1906 | Arnold, Frank Arthur |
| 1904 | Augustine, Henry Joshua |
| 1906 | Bate, John Brabant |
| 1904 | Bennett, Arthur King |
| 1906 | Bennetts, Harold Graves |
| 1907 | Bond, Ashton |
| 1907 | Branch, Stanley |
| 1905 | Brown, Alexander |
| 1904 | Bruce, William James |
| 1904 | Byrne, John Scott |
| 1905 | Caldwell, Thomas Cathcart |
| 1906 | Carter, Robert Markham |
| 1906 | Chisholm, James Alexander |
| 1904 | Clayton, Thomas Morrison |
| 1906 | Clements, Robert William |
| 1907 | Collinson, Walter Julius |
| 1905 | Critien, Attilio |
| 1904 | Dalziel, John McEwen |
| 1907 | Davey, John Bernard |
| 1904 | Dee, Peter |
| 1907 | Donaldson, Anson Scott |
| 1906 | Dundas, James |
| 1906 | Faichnie, Norman |
| 1907 | Fell, Matthew Henry Gregson |
| 1907 | Gann, Thomas William Francis |
| 1907 | Graham, James Drummond |
| 1904 | Greenidge, Oliver Campbell |
| 1904 | Hehir, Patrick |
| 1907 | Hiscock, Robert Carroll |
| 1905 | Hooton, Alfred |
| 1905 | Hudson, Charles Tilson |
| 1905 | Illington, Edmund Moritz |
| 1906 | Jeffreys, Herbert Castelman |

| *Date of Diploma* | |
|---|---|
| 1907 | Keane, Joseph Gerald |
| 1907 | Kennan, Richard Henry |
| 1907 | Kenrick, William Hamilton |
| 1904 | Khan, Saiduzzafor |
| 1904 | Laurie, Robert |
| 1907 | Le Fanu, George Ernest Hugh |
| 1905 | Macfarlane, Robert Maxwell |
| 1906 | Mackenzie, Donald Francis |
| 1907 | Mackey, Charles |
| 1904 | Maclurkin, Alfred Robert |
| 1905 | Maddock, Edward Cecil Gordon |
| 1907 | Maddox, Ralph Henry |
| 1907 | McCarthy, John McDonald |
| 1904 | McConnell, Robert Ernest |
| 1905 | Moore, James Jackson |
| 1904 | Nicholson, James Edward |
| 1905 | Nightingale, Samuel Shore |
| 1906 | Pailthorpe, Mary Elizabeth |
| 1906 | Palmer, Harold Thornbury |
| 1906 | Pearse, Albert |
| 1904 | Philipson, Nicholas |
| 1905 | Radcliffe, Percy Alexander Hurst |
| 1907 | Raikes, Cuthbert Taunton |
| 1907 | Ryan, Joseph Charles |
| 1906 | Sampey, Alexander William |
| 1904 | Sharman, Eric Harding |
| 1906 | Smithson, Arthur Ernest |
| 1906 | Taylor, Joseph van Someron |
| 1906 | Taylor, William Irwin |
| 1904 | Thomson, Frank Wyville |
| 1906 | Tynan, Edward Joseph |
| 1907 | Vallance, Hugh |
| 1904 | Walker, George Francis Clegg |
| 1906 | Watson, Cecil Francis |
| 1906 | Willcocks, Roger Durant |
| 1906 | Williamson, George Alexander |
| 1905 | Young, John Cameron |

# EDITORIAL NOTICE

By order of the Committee of the Incorporated Liverpool School of Tropical Medicine, the series of the Reports of the School, which have been issued since 1899, will be followed, from January 1, 1907, by the Annals of Tropical Medicine and Parasitology, of which this is the fourth number.

The Annals are issued by the Committee of the School, and will contain all such matter as was formerly printed in the Reports—that is to say, accounts of the various expeditions of the School and of the scientific work done in its laboratories at the University of Liverpool and at Runcorn. Altogether twenty-one Memoirs, besides other works, have been published by the School since 1899, and of these ten, containing 519 quarto or octavo pages and 95 plates and figures, were published during the two years 1904 and 1905; and there is no reason to suppose that this rate of production by the workers of the School alone will diminish in the future. In addition, however, to School work, original articles from outside on any subject connected with Tropical Medicine or Hygiene may be published if found suitable (see notice on back of cover); so that, in all probability, not less than four numbers of the Annals will be issued annually. Each number will be brought out when material sufficient for it has been accumulated.

# OBSERVATIONS ON THE SO-CALLED 'CANARY FEVER'

# OBSERVATIONS ON THE SO-CALLED 'CANARY FEVER'

BY

C. E. WALKER

ASSISTANT DIRECTOR OF CANCER RESEARCH AND HONORARY LECTURER ON CYTOLOGY TO THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE IN THE UNIVERSITY OF LIVERPOOL

*(Received for publication October 4th, 1907)*

Hitherto the evidence regarding the disease commonly known as 'Canary Fever,' has been of a most conflicting character. Very frequently the disorder is of a comparatively trifling nature, and such cases do not usually come to the knowledge of a medical man. Private enquiry points to the probability that from 60 to 80 per cent. of the visitors to the Island suffer from one or more attacks during the time that they are in the islands. Dr. Taylor, who has practised among the English visitors in Las Palmas for many years, estimates that only about 5 per cent. of the cases that occur come under the observation of a medical man.

The disease is apparently more prevalent during the winter months than during the summer, but this is probably due to the fact that larger quantities of food are consumed during the former period owing to the larger number of visitors, and that as flies are then more numerous, there is, as we shall see later, a much greater chance of the food becoming infected.

Clinically the disease is characterised by the suddenness of its onset, and by its generally attacking a number of individuals in the same hotel at the same time. Frequently it commences with vomiting, and as a rule, even when vomiting does not actually occur, there is a considerable feeling of nausea which lasts for from a few hours to two or three days. A few hours after the vomiting or nausea, sometimes synchronously with it, griping pains in the abdomen of a violent character commence. This is the most marked and constant symptom, and causes very considerable suffering. The patient now developes a more or less acute attack of diarrhoea. In the more acute

cases the discharge frequently becomes mucous in character, and is sometimes blood-stained. Sometimes the temperature rises, but not, as a rule, to any considerable extent. The length of the attack varies in different cases; a slight one but for two or three days, the more serious for two or three weeks.

The disorder has been attributed to various causes. The red wine of the country, the water, an excess of fruit, too much food, and too little exercise have all been blamed. The most superficial examination of the available evidence, however, shows that none of these can be the usual cause of the disease. Individuals who are teetotalers are as frequently attacked as those who never drink water. Those who eat a quantity of fruit are no more subject to it than those who abstain from fruit altogether.

Enquiries made with regard to the milk supply showed that the dairies in the town of Las Palmas, where the cows are stall-fed, are generally remarkably clean. These dairies do not, however, supply enough milk to meet the demands of visitors, and a large proportion of it is brought down from the country. The milk supply is generally the same in the case of the hotels as it is in the case of the private houses, which fact, as we shall see later, is of special significance. Also I was able to ascertain that people who drank large quantities of milk in private houses were not subject to the disease, while those in the hotels who never touched milk were subject to it.

With regard to the water supply, there is no evidence incriminating it, for people who have stayed in hotels with a certain water supply have suffered from the disease, while people in private houses with a water supply derived from the same source have been free from it.

The most significant fact which was ascertained at the commencement of the enquiry was, that while visitors at hotels so frequently contracted the disease, it was practically unknown among people living in private houses. Dr. Taylor informs me that among English people who live in private houses the disorder is very rare, and that in his experience it is confined to visitors at the hotels. This coincides entirely with the personal evidence I was able to obtain.

Dr. Millares also informs me that the disease, in his experience, is practically confined to the hotels.

Typhoid appears to be comparatively common among the lower classes of natives, but I was able to ascertain the occurrence of only

two cases during the past three years in hotels, and in both these there was very good evidence that the infection had occurred outside the hotels in which the men were staying.

These facts suggested the advisability of a comparison between the sources of food supply and the methods of keeping and cooking the food in hotels with those in private houses.

The meat for hotels, in some cases at any rate, is frequently frozen meat brought to the islands by ship. It often happens that this meat is more or less exposed on the quay for several hours—sometimes for more than twelve when a steamer arrives early in the night.

The larders in many hotels are not fly proof, and the food-stuff is not adequately protected from flies before and after cooking. In some cases it is not protected at all.

Soup in the hotels is frequently made in a stock-pot which is only emptied once or twice during the week.

In private houses the meat supply is generally from animals killed in the islands. Considerable precautions are usually taken to protect all food from flies. This precaution extends not only to keeping meat, fish, &c., in fly proof safes, but even dishes of fruit are often covered with muslin while on the table. Soups are made fresh every day, and a stock-pot is not used.

In some of the butchers' shops (in Las Palmas, for instance) one frequently sees meat exposed for sale which is not protected from flies. I have been unable to trace the destiny of this meat. In the case of the private houses where I was able to trace the source of the meat supply, I found that a servant was sent early in the morning to the market. This meat is stated to be freshly killed. It must also be observed that the evidence with regard to the occurrence of the disease which is here given applies only to the better class of natives, and not to the lower classes.

Flies are extremely numerous, particularly during the time of the year when most visitors are staying in the hotels. They always swarm to an extent which can but rarely happen, even in isolated cases, in more temperate climates. Again, the habits of the lower classes among the natives are such as give perhaps the greatest possible number of chances of infection of the food with various micro-organisms by means of the flies. For instance, the inhabitants usually defaecate in any spot that suits their personal convenience, and one spot

favoured particularly by them in this way is not many yards away from the unprotected larder window of one of the hotels. This instance is only quoted as one among a large number.

Temperature seems also to have a very marked effect upon the frequency of the disorder. In Las Palmas, for instance, the summer and winter temperatures vary only by about 10 degrees, and the temperature does not usually go below about 75°F., so that any bacteria carried on to food-stuff by flies would be under very favourable conditions for rapid multiplication. In the Monte district of the same island the temperature is much more variable, and during the winter is comparatively low. In this district cases of so-called Canary fever are comparatively rare in the hotels.

These observations indicate that there should be a greater risk of conveying a large dose of bacteria, and of the toxins they produce, by means of soup from the stock-pot and of rechauffés, than by any other kind of food. The soup is rarely if ever brought to boiling point, and necessarily is allowed to cool every night when the kitchen fire goes out. Entrées and other forms of rechauffés are made from meat or fish that has been previously cooked, and such material will have been left for from 18 to 24 hours before being served without having been brought up to the boiling point of water. Micro-organisms will have been destroyed, and many of their toxic products may have been disintegrated by the temperature generally required to cook food for the first time, and with such material the risk of infection or poisoning will be much less than in the case of the soup from the stock-pot or of a rechauffé which is rarely if ever brought up to a sufficiently high temperature.

During my stay in Las Palmas, most of the other visitors in the hotel had attacks of the disorder. My two companions and I avoided soups and entrées, and also avoided infection. On one occasion, however, one of my companions took an entrée. An attack followed within a few hours. This certainly might be interpreted as a coincidence, but when taken in conjunction with the fact that the disease is confined to the hotels, and keeping in mind the difference in the method of keeping food in the private houses, it might also be regarded as corroborative evidence.

The symptoms of the disorder, its epidemic character, and its being confined to hotels, suggest very strongly that it is due to

bacterial infection of the food. The details which have been given regarding the differences between the methods pursued in hotels and in private houses, suggests that the infection is largely brought about by flies carrying the bacteria on to the food, in which position the conditions are particularly favourable as regards temperature and nourishment for their rapid multiplication. This does not necessarily suggest any specific micro-organism, but is amply sufficient to account for all the cases of Canary fever that occur. There is, however, another cause which might explain some cases, which I have proved by personal experience to be sufficient to produce all the symptoms of the so-called fever. If two or three men live for many days upon a small boat during the summer months in England, they will very likely be suddenly attacked by these symptoms in an acute form unless all their cooking utensils, plates, forks, &c., be thoroughly cleaned and boiled at frequent intervals. The temperature below deck and in the lockers in a small boat in British waters will frequently be very high during the summer, and there will be very favourable conditions for the multiplication of bacteria in any small collections of grease, &c., on the cooking and other utensils.

I have been able to find no evidence that any utensils are ever boiled in the hotels.

The following measures should be adopted in order to avoid, or at least materially lessen, the chances of food becoming infected:—

Meat and fish, particularly, should be protected from flies in as effective a manner as possible before it is brought into the hotels.

When in the hotels all food should be protected from flies; the larder should be entirely fly-proof; the entrance should be protected by two doors, between which there is room for a man to stand; both these doors should close automatically with springs, and it would be well to have some simple automatic arrangement which would prevent one being opened until the other was closed. It should be easy to catch the few flies that might possibly get into the larder, in spite of these precautions, by means of fly traps.

Of course the best plan would be to keep the food in a chamber which was constantly below freezing point. When the food was removed, once or perhaps twice during the day, it should be kept in fly-proof receptacles.

Meat should be kept hanging up, and not laid upon shelves.

Shelves and tables in the larder, serving rooms and kitchens should be made of some non-absorptive material, such as marble or slate. Most of the shelves and tables upon which the food was placed during the processes of cooking and serving which I saw in the islands were made of soft wood. No matter how much this wood be scrubbed, there must always be a certain amount of organic material in a more or less advanced stage of decomposition in the cracks. In the serving rooms, kitchens, &c., and wherever food is exposed for any length of time to contagion by flies, the food should be covered up as soon as it is put down. The ordinary wire gauze dish covers are cheap, and admirably suited to this purpose.

Cooking utensils, plates, dishes, forks, spoons, &c., should be sterilized shortly before use. This would not involve any very considerable extra labour, and convenient apparatus would not be very costly. No pressure of steam would be necessary, only the utensils should be brought to the temperature of steam. Cleaning with a jet of live steam, such as is done on ships, would be very effective.

Copper cooking utensils have the disadvantage that they require re-tinning at intervals. There is no means of getting this done in a first-class manner in the islands. The tinning is often irregular, and it is impracticable to get such a surface really clean and free from small collections of organic material. Something other than copper would, therefore, be an advantage.

Soup must be made fresh every day, and the stock-pot abolished.

With regard to rechauffés, even if protection from flies is guaranteed between the first and second cooking, it would be well if the material were always brought to boiling point and kept so for some minutes.

Cold cooked provisions must be kept free from flies.

There should be but little difficulty in keeping the kitchen, and even the whole house, comparatively free from flies by means of wire gauze frames to the windows and double doors: the outside door to consist of a frame with wire gauze stretched upon it. Such a plan would allow plenty of air to come into the rooms, and would exclude the majority of the flies. This is done very extensively in America, and even by some people in England.

No suggestion is intended that the kitchens of the hotels are not

clean in the ordinary acceptance of the word. For instance, the kitchens of those I visited would compare very favourably with any kitchen I have seen in Europe.

What the observations really imply is that precautions which are sufficient in England to prevent a degree of infection by bacteria enough to produce symptoms, are wholly inadequate under the conditions of temperature, &c., in the lower and hotter parts of the islands.

It is quite possible that there may be one or more specific bacteria which are specially responsible for the acuteness of the symptoms. Even if this be the case, however, there seems but little doubt that the flies are to a large extent responsible for the original infection of the food. The rapid multiplication of the bacteria and the consequent production of toxins depends upon the local conditions. It would seem that the suggested precautions are necessary whether there be a specific micro-organism or not. It is probable that food is more frequently infected, even in the best conducted private kitchens in the towns in the islands, than is the case in Europe, and that consequently the residents may have acquired a limited degree of immunity. I met several residents, however, who told me that they had suffered from attacks after dining at hotels, but not at any other time.

The term 'Canary Fever' is obviously a misnomer. It would appear probable that a bacterial infection of the food must frequently happen, and similar epidemics be produced in other tropical and sub-tropical countries where similar conditions prevail.

I wish to acknowledge the great assistance given to me by Dr. Taylor and by Dr. Millares. Their local knowledge was of the greatest value. The enquiry was much facilitated by the ready help and great frankness with regard to the facts that had come within his knowledge, shown to me by Mr. Sauerbrei, the manager of the Hotel Metropole at Las Palmas.

# CONTRIBUTION A L'ETUDE DE *POROCEPHALUS MONILIFORMIS*

# CONTRIBUTION A L'ETUDE DE *POROCEPHALUS MONILIFORMIS*

PAR

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DIRECTEUR DU LABORATOIRE

ET

J. RODHAIN

MÉDECIN DE L'HÔPITAL DES NOIRS

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(*Received November 13th*, 1907)

Nous avons eu récemment l'occasion d'observer à Léopoldville, plusieurs cas d'infection par des larves de *Porocephalus moniliformis*, un cas chez l'homme, quatre cas chez le singe.

Les infections par ce parasite doivent être dans le bassin du Congo comme ailleurs, extrêmement rares. Dans les nombreuses autopsies d'hommes et d'animaux les plus divers que nous avons faites depuis 1900 à Léopoldville, à Lusambo et dans l'Ubangi, nous n'avions jamais rencontré de larves de ce parasite. Dutton et Todd* qui ont fait au Congo également de nombreuses autopsies, n'ont pas signalé de ces larves.

## HISTORIQUE

Pour autant que la littérature nous est accessible ici, peu de cas d'infection par *Porocephalus moniliformis* semblent avoir été signalés. Rencontrées une première fois par Pruner en 1846 dans le foie de deux nègres au Caire, des larves furent signalées ensuite par Bilharz, Fenger, Aitken, Giard, Chalmers. Tous ces cas se rapportent à des infections chez l'homme.

Nous donnons cette littérature d'après Braun.[1] Depuis 1899, date de la publication de l'observation de Chalmers, il ne semble pas avoir été signalé de nouveau cas.

* During the autopsies of thirty odd natives and some scores of monkeys (*Cercopithecus sp.*), we saw *Porocephalus sp.* four times; twice in man, twice in monkeys; and in each instance the parasite was firmly encapsuled in the liver. (J. L. Todd).

[1] Braun. Thierische Parasiten des Menschen. 3 Aufl. 1903.

D'après les observations de ces différents Auteurs, les larves de *Porocephalus* s'enkystent dans le foie, dans la muqueuse intestinale, dans le poumon. Chalmers[2] en a retrouvé à l'autopsie de nombreux exemplaires libres dans la cavité péritonéale et dans l'intestin grêle.

Dans certains cas, observations Aitken, Chalmers, le parasite semble avoir été la cause directe de la mort par pneumonie ou péritonite.

Chez l'animal les larves de *Porocephalus moniliformis* ont été rarement constatées. Pruner en a signalé chez la girafe, d'autres Auteurs chez l'hyène, le *Cynocephalus mormon* et le *Cercopithecus albogularis* (Looss[3]).

Looss se range à l'avis de Neumann[4] qui considère les larves de *Porocephalus* signalées jusqu'à présent chez l'homme et quelques animaux, comme la forme jeune de *Porocephalus moniliformis*, Diesing. Celle-ci se rencontre dans les poumons des grands serpents africains.

L'évolution du parasite n'est pas connue avec certitude. D'après Looss, elle doit être analogue à celle de *Linguatula rhinaria*.

## OBSERVATIONS PERSONNELLES

Le 11.V.07 est amené à l'hôpital des noirs à Léopoldville, le soldat Bangala-Mingi, se plaignant de vives douleurs dans le flanc gauche. Un examen superficiel dénotant un état général grave, le malade est gardé en observation.

De l'interrogatoire et de l'examen faits par l'un de nous, nous retenons les faits suivants :

Le soldat est arrivé à Léopoldville au commencement d'avril 1907 ; avec un détachement il est parti à l'intérieur du district, où il serait devenu souffrant vers le 15 avril. A ses camarades il se serait plaint alors de vagues douleurs dans le flanc gauche et de constipation.

C'est un homme largement bâti, à bonne musculature, à nutrition bien conservée. L'attention est attirée immédiatement par l'abdomen dont la moitié gauche est fortement bombée. A la

2 Centrlb. f. Bakter. 1899, Bd. XXVI, p. 518.

3 In Mense, Handb. f. Tropenkrankheiten, Bd. I, p. 198.

4 Porocéph. du chien et de quelq. mammif. Arch. de Paras. II, 1899. Ce travail ne nous a pas été accessible ici.

palpation l'abdomen présente une résistance uniforme, assez marquée, une résistance anormale dans l'hypochondre gauche et en partie dans l'épigastre. La palpation est très douloureuse en cette région et ne permet pas une délimitation exacte. A la percussion, il y a une sonorité tympanique élevée au niveau de l'hypochondre et du flanc gauches, sans limites nettes. La limite antéro-inférieure de la rate n'est pas décelable; le foie n'est pas augmenté. Le cœur ne présente pas d'altérations. Le poumon gauche présente un peu d'engorgement à la base, le poumon droit normal.

Pas de trypanosomiase. L'examen du sang révèle augmentation notable des leucocytes (myélocytes). La température est fébrile, 37·8° C., le pouls très accéléré, filant.

Le malade se plaignant de n'avoir pas eu de selles depuis 15 jours, prend un purgatif qui provoque 2 selles.

Dans la nuit du 11 au 12.V.07 le malade a des vomissements sanguinolents dont l'examen ne dénote rien de particulier.

Le malade est très abattu, refuse toute nourriture. Il meurt brusquement dans la nuit du 12 au 13.

Cette sommaire histoire clinique ne nous donne guère d'indications nettes sur la nature de la maladie. Aussi nous nous étions bornés à supposer l'existence d'une tumeur abdominale de nature indéterminée.

*Autopsie.*—Commencée le 13 à 7 heures du matin. Cadavre d'un homme normalement conformé, dans un état de nutrition bien conservé. En rigidité cadavérique; pas de lésions cutanées. L'abdomen est fortement ballonné, la peau y est très tendue; la sonorité à la percussion est d'un tympanisme élevé sur toute la paroi abdominale antérieure.

Après incision de la paroi, il s'échappe de la cavité abdominale des gaz fétides en même temps qu'un liquide épais, sanguinolent, couleur rouge lie-de-vin. La cavité péritonéale renferme environ 200 cc. de ce liquide. A l'examen microscopique on y trouve peu de leucocytes dégénérés, de nombreux bacilles longs, immobiles, isolés, en chaînettes plus ou moins longues ou en filaments.

L'estomac et l'intestin grêle sont fortement distendus par des gaz. Le long de la grande courbure de l'estomac, occupant tout l'hypochondre gauche, il y a une poche à parois assez épaisses, présentant à la face externe de nombreuses tâches hémorrhagiques d'un rouge violacé. Au palper, cette poche ne présente qu'une

résistance molle, plus ou moins fluctuante. Elle est intimement adhérente d'un côté à la grande courbure de l'estomac et à l'extrémité de lobe gauche du foie, en bas à la partie gauche du colon transverse, en haut à la face inférieure du diaphragme, du côté externe à la face interne des côtes, en arrière à la paroi abdominale postérieure.

En examinant les rapports de la poche, avec le gros intestin, nous retournons le grand épiploon, et remarquons à la face postérieure de celui-ci, près du colon transverse, une *larve* non enkystée, vivante, d'un blanc laiteux ; l'extrémité céphalique est largement arrondie, la moitié postérieure s'amincit graduellement et se termine en cône ; le corps présente sur toute son étendue des épaissements annulaires, rappelant à première vue, du moins dans la moitié postérieure, les tours de spire d'une vrille. La larve est légèrement fixée à l'épiploon par son extrémité céphalique ; elle s'en détache facilement et est mise dans de l'eau physiologique où elle continue ses mouvements lents de contraction et d'extension.

A l'incision de la poche, il s'écoule en jet un liquide épais, trouble, sanguinolent, d'un rouge lie-de-vin ; par compression, il en sort comme des caillots de sang nombreux et épais. Incisée largement, la poche est encore remplie à moitié par une bouillie assez épaisse, dans laquelle se reconnaissent des tractus fibreux de la rate. A la paroi de la poche, nous ne trouvons pas d'autre solution de continuité que celle provoquée par le couteau d'autopsie. L'examen microscopique du contenu de la poche montre à côté d'éléments cellulaires plus ou moins bien conservés, de nombreux bacilles longs, identiques à ceux signalés déjà dans l'exsudat abdominal.

*Foie*: n'est pas hypertrophié, est d'un jaune pâle. Sur la face antéro-supérieure, le feuillet péritonéal viscéral est particulièrement soulevé par des gaz. Dans la pulpe l'examen dénote la présence de nombreux bacilles identiques à ceux déjà signalés.

*Estomac :* la face externe ne présente pas de lésions macroscopiques. La muqueuse stomacale présente en differents endroits de petites suffusions hémorrhagiques. L'estomac ne présente pas de communications avec la poche.

*Oesophage :* pas de lésions macroscopiques.

*Intestin grêle :* uniformément distendu par les gaz, présente à la surface externe, en de nombreux endroits, des tâches hémorrhagiques, petites, irrégulières, d'un rouge vif. Incisé sur toute sa longeur, il ne

présente pas d'ulcérations ni de perforations. Dans la partie supérieure, il renferme de rare *Ankylostomum.*

*Gros intestin:* présente également à la face externe de petites suffusions hémorrhagiques, irrégulièrement disséminées ; pas d'autres altérations macroscopiques. Dans le contenu du rectum, rares œufs *d'Ankylostomum,* pas d'autres parasites.

*Reins, vessie:* pas d'altérations macroscopiques.

*Cage thoracique:* au poumon droit, pas de lésions macroscopiques. Dans la cavité pleurale droite, quelques c.c. d'exsudat, renfermant des bacilles identiques à ceux de l'exsudat abdominal.

Le poumon gauche, par toute sa surface, présente des adhérences fortes, fibrineuses, anciennes, avec la face interne de la paroi thoracique ; la base du poumon adhère fortement au diaphragme, qui à ce niveau présente des suffusions hémorrhagiques. Le lobe inférieure présente à la base en arrière, des noyaux fortement congestionnés.

*Cœur:* le péricarde renferme environ 50 c.c. d'exsudat sanguinolent, très riche en longs bacilles ; il en est de même du sang du cœur. Les valvules sont fortement hyperémiées, mais ne présentent pas d'autres lésions.

Les *Cultures* sur agar et en bouillon faites avec l'exsudat abdominal et le sang du cœur, ont donné : celles sur agar, 2 colonies de micrococques : celles en bouillon, une culture serrée de coques. Les bacilles longs signalés à l'examen microscopique, appartenaient donc à une espèce anaerobie. Les coques n'ont pas été identifiés. Les bacilles ne se colorent pas par le gram.

## CARACTÈRES DE LA LARVE

1. Elle se présente sous forme d'un petit vermicule, d'un blanc laiteux ; le corps est arrondi, composé d'une série d'anneaux, dont le bord postérieur est épaissi et surplombe un peu le segment suivant. L'extrémité céphalique vue par la face dorsale est largement arrondie. A 1·5 mm. environ du bord antérieur se voit un premier sillon peu profond, suivi bientôt d'une série d'autres très nets.

A la face ventrale, l'etrémité céphalique présente à 1 mm. environ du bord antérieur, sur la ligne médiane, un petit orifice circulaire, ou ouverture buccale. Celle-ci ne présente pas d'appendices.

De chaque côté de la bouche, disposés symétriquement, il y a deux

crochets très pointus, d'un jaune d'ambre. Ces crochets, que l'animal sort et rentre altérnativement, sont logés dans une dépression de tegument, où ils sont peu visibles au repos ou après la mort.

A un peu plus de 1 mm. en arrière de l'ouverture buccale, se voit une première indication de sillon.

2. *Corps*: se continue avec l'extrémité céphalique sans différenciation. Il est composé d'une série d'anneaux, les premiers, près de l'extrémité céphalique, étant peu distincts. Ces anneaux ou segments sont au repos, beaucoup plus larges que longs. Vers le bord postérieur ils s'élargissent un peu et s'epaisissent notablement de façon à surplomber la partie antérieure du segment suivant.

La section du corps n'est pas exactement circulaire: la face dorsale est arrondie, mais la face ventrale est aplatie. Dans la moitié postérieure même, la face ventrale présente une surface légèrement concave. Cette concavité est produite par une disposition spéciale du bord postérieur des anneaux à cet endroit. A partir du 10e segment, le bord postérieur à la face ventrale s'amincit un peu de chaque côté de la ligne médiane et au niveau de celle-ci présente une échancrure à concavité dirigée vers la tête. Cette succession d'amincissements et d'échancrures produit une espèce de sillon peu profond.

Le tegument du corps ne présente aucun détail de structure; le bord postérieur des segments ne porte aucune espèce d'appendices.

Le corps est divisé en 18 anneaux plus ou moins nettement distincts, auxquels il faut ajouter le segment portant la bouche et les crochets ou extrémité céphalique et le segment final ou extrémité postérieure. Ce qui ferait 20 segments, mais nous verrons que le dernier anneau présente encore des indications de subdivisions.

3. *Extrémité postérieure:* à l'œil nu se présente sous forme d'un segment conique à pointe obtuse. A un grossissement convenable, on y distingue surtout à la face ventrale, deux épaisissements analogues au bord postérieur des segments du corps, et partageant donc en réalité le segment terminale en 3 petits segments peu distincts. Cela porterait le nombre total des segments à 22.

A la pointe du segment terminal, est un orifice sous forme de fente transversale—orifice d'excrétion (?).

*Dimensions de la larve:* Durant la vie, les dimensions varient suivant l'état de contraction, ou d'extension de l'animal. La plus

grande longueur que nous ayons mesurée, les trois-quarts environ des anneaux étant en extension, était de 23 mm. Après la mort et fixation par le sublimé, puis alcool à 70%, la longueur est de 16 mm., la largeur de 2 à 2·5 mm., la plus grande largeur correspondant à l'extrémité céphalique, immédiatement en arrière de l'orifice buccale.

La larve extraite à l'autopsie le 13.V.07 dans la matinée put être gardée en vie dans de l'eau physiologique et du sérum du sang de bœuf pendant 6 jours : elle fut trouvée morte le matin le 19.V.07.

Cette larve présente des caractères identiques à ceux decrits par différents Auteurs pour d'autres exemplaires rencontrés chez l'homme, et denommés *Pentastomum constrictum*, von Siebold 1852, *Porocephalus constrictus*, Stiles 1893. Comme nous l'avons dit plus haut, Looss et Neumann considerent ces larves comme la forme jeune de *Porocephalus moniliformis*, Diesing, 1836. Nous adoptons cette dénomination qui nous paraît la plus rationnelle.

Quels ont été les rapports de cette larve de *Porocephalus* avec la maladie et même la mort de notre sujet?

Différents Auteurs ont signalé les ravages causés dans l'organisme par une ou plusieures de ces larves. Les faits constatés jusqu'à présent tendent à prouver que les embryons parvenus de l'une ou de l'autre façon dans les organes, s'y enkystent et s'y développent. Arrivée à un certain stage de développement, la larve romprait la poche et chercherait à sortir de l'organisme dans lequel elle est emprisonnée, pour gagner l'extérieur. Par les crochets dont elle est armée, par sa taille, elle doit nécessairement alors occasionner de graves désordres.

En examinant les lésions macroscopiques constatées à l'autopsie de notre sujet, nous pouvons dire que cet homme à succombé à une *péritonite suraigue consécutive à une fonte purulente de la rate.* Quelle a été la cause des modifications considérables produites dans la rate? Nous ne croyons pas nous tromper en les attribuant à la larve de *Porocephalus.* L'embryon s'est enkysté, s'est développé dans cet organe. Arrivé à un certain stage de développement, la larve a rompu le kyste et a cherché à sortir de l'organe qui l'emprisonnait. Elle a dû produire ainsi une irritation considérable suivie bientôt d'une réaction inflammatoire intense. Ainsi s'expliquent les douleurs accusées par notre malade déjà plus d'un mois avant la mort. Sur ces lésions, s'est greffée une infection microbienne, occasionnant une

véritable fonte purulente de la rate avec un développement considérable de gaz. Peut-être, immédiatement après la perforation de la poche par la larve, s'est développée la péritonite suraigue. Les caractères morphologiques et biologiques du bacille, signalé dans l'abcès, les divers exsudats et le sang du cœur, nous incitent à croire que nous avons eu affaire au bacille de l'oedème malin.

## LARVES DE *POROCEPHALUS* CHEZ LE SINGE

Peu de semaines après le cas du nègre que nous venons de relater, nous avons eu la bonne fortune de retrouver de nombreuses larves de *Porocephalus* chez un singe, *Macacus* (*sp.* ?).

Ce singe avait été acheté à Léopoldville à un noir descendu du Haut-Congo ; il ne paraissait pas malade et fut gardé en captivité pendant plusieurs semaines. Il fut trouvé mort le matin du 10.VII.07. Bien qu'il n'eût pas servi de sujet d'expériences, nous en fîmes l'autopsie pour déterminer la cause de la mort et contrôler la parasitologie intestinale. A notre grand étonnement, nous trouvâmes de nombreuses larves de *Porocephalus*, 8 enkystées dans le grand épiploon, 1 dans le mésentère, 2 à la face inférieure du diaphragme. Nous en donnons plus loin une description sommaire.

Le 3.IX.07, un autre de nos singes *Macacus* (*sp.* ?), de même espèce que le précédent, mourut dans la journée. N'ayant pas servi aux expériences, l'animal fut néanmoins autopsié.

Il présentait dans la cavité abdominale de nombreuses larves de *Porocephalus*: 7 enkystées dans le grand épiploon, 2 dans le mésentère, 1 fixée à la face inférieure du diaphragme, 2 fixées à la paroi du petit bassin.

Pas de lésions macroscopiques des organes.

Le 4.IX.07, un troisième de nos singes *Macacus*, de même espèce que les précédents, succomba. A l'autopsie, nous trouvâmes 13 larves de *Porocephalus* enkystées dans le grand épiploon.

Pas de lésions macroscopiques des organes.

Le 23.IX.07, un 4ième singe, de même espèce que les précédents, fut trouvé mort. Comme chez les autres, le grand épiploon renfermait 12 larves enkystées de *Porocephalus*.

Pas de lésions macroscopiques des organes.

Ce dernier singe avait paru indisposé à certains moments.

Fréquemment on l'avait trouvé étendu, couché sur le ventre, comme s'il souffrait de douleurs abdominales.

Chez ces 4 singes, les larves de *Porocephalus* montraient une disposition identique.

L'immense majorité des larves était fixée au grand épiploon, quelques unes au mésentère, de très rares au péritoine pariétal : pas une seule dans les organes, comme le foie ou la rate.

Comme le montre la photographie faite du grand épiploon du singe No. 3, les larves sont enroulées sur elles-mêmes, entourées d'une mince membrane kystique, à travers laquelle les segments du corps sont visibles. En incisant la membrane près de l'une des extrémités de la larve, une légère pression suffit pour faire sortir le ver de la poche.

La membrane qui enferme la larve, est fibrineuse, très mince, ne montre pas de vascularisation. Le petit kyste qu'elle forme, renferme outre la larve, une très petite quantité de liquide un peu trouble, mais sans éléments cellulaires.

Ce kyste est intimement adhérent à l'épiploon ou au péritoine pariétal, sur lequel il est fixé : on ne peut l'en détacher sans déchirer la séreuse.

Immédiatement autour du kyste, ni l'épiploon, ni le mésentère, ni le péritoine pariétal, ne présentent d'altérations macroscopiques permettant de croire à une réaction cellulaire. Le même dans la cavité abdominale, il n'y avait pas de lésions macroscopiques des organes ni d'exsudat.

L'une ou l'autre des larves, enlevée du kyste et mise dans l'eau physiologique, ont présenté des mouvements analogues à ceux décrits pour la larve du nègre. Elles n'y ont vécu que durant 48 heures au maximum.

Les caractères morphologiques sont identiques à ceux décrits pour la larve du nègre. Alors que celle-ci après fixation au sublimé, a une longueur de 16 mm., une largeur de 2 à 2·5 mm., celles des singes n'ont que 10 à 12 mm. de long, et 2 mm. de large.

*Mode d'infection* : En présence des cas répétés d'infection par des larves de *Porocephalus* chez des singes tenus en captivité au même endroit, nous devons nous demander si ces animaux ne se sont pas infectés à une source commune.

Ces singes étaient gardés à la chaîne sous la vérandah d'une

habitation, et pouvaient se promener dans un certain rayon sur le sol qui entoure la maison. Ils recevaient comme nourriture de la chikwangue, du pain et du riz cuit, de temps à autre une banane. Tous avaient été achetés, 2, 3 ou 4 mois auparavant à des nègres descendus avec ces animaux du Haut-Congo: il ne fut donc pas possible de connaître plus exactement leur lieu d'origine.

Des quatre singes, seul le 4ième avait de temps à autre montré des signes d'indisposition, en se couchant à plat ventre durant des heures, refusant toute nourriture.

Actuellement nous possédons encore deux singes qui ont été en captivité dans le voisinage immédiat des quatre qui ont succombé et en contact continu avec eux pendant des semaines. Jusqu'à présent ni l'un ni l'autre de ces singes ne présentent des symptômes de maladie.

Si l'on admet pour *Porocephalus moniliformis*, une évolution analogue à celle de *Linguatula*, nos singes auraient dû être infectés par les œufs provenant d'un animal hôte de la forme sexuelle, adulte. Looss, avec Neumann, admet que les grands serpents africains constituent les hôtes des formes adultes. A Léopoldville, les grands serpents sont rélativement rares, et si nos singes ont été infectés pendant qu'ils étaient en captivité chez nous, comme nous sommes portés à le croire, nous serions plutôt tentés d'admettre que les œufs de *Porocephalus* proviendraient d'un autre animal qu'un serpent. D'un autre côté, il ne serait certainement pas impossible que des œufs renfermant un embryon, et très résistants d'après Looss, avaient été véhiculés d'une certaine distance jusqu'à notre laboratoire.

Des circonstances materielles ne nous ont pas permis d'essayer d'infecter d'autres animaux avec les larves provenant des singes.

Dès que l'occasion se présentera, nous examinerons des serpents et d'autres animaux sauvages pour tâcher de retrouver la forme adulte de *Porocephalus moniliformis*.

## EXPLICATION DE LA PLANCHE

Fig. 1.—Extrémité antérieure de larve de *Porocephalus moniliformis* du nègre, vue par la face dorsale : Gross. 5 diam.

Fig. 2.—Extrémité antérieure, *id*, vue par la face ventrale.

Fig. 3. Larve de *Porocephalus moniliformis* du nègre, vue par la face ventrale : Photographie en grandeur naturelle.

Fig. 4.—Larve, *id*, vue par la face dorsale : Photographie, *id*.

Fig. 5.—Grand épiploon du singe No. 3, avec larves enkystées : Photographie $\frac{3}{4}$ grandeur naturelle.

PLATE XLIII

Fig. 1

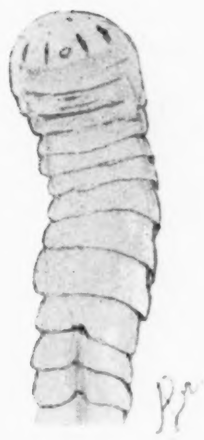

Fig. 2

Fig. 3

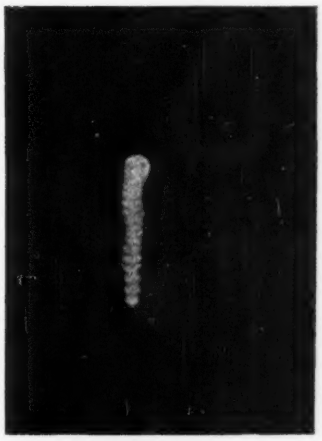

Fig. 4

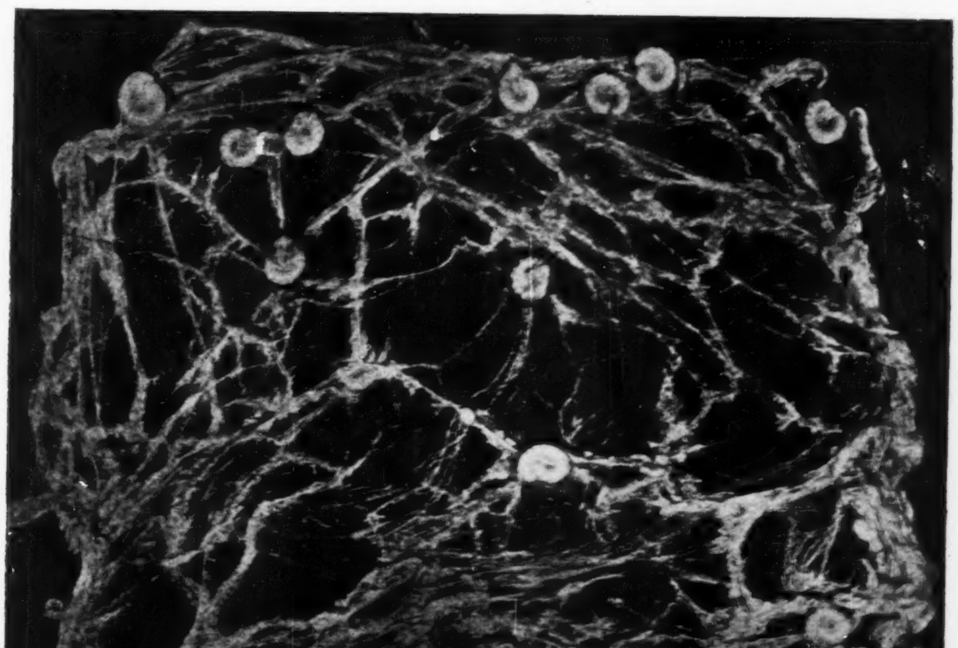

Fig. 5

Broden, phot.

# ON THE HABITS, LIFE-CYCLE AND BREEDING PLACES OF THE COMMON HOUSE-FLY (*MUSCA DOMESTICA*, Linn.)

# ON THE HABITS, LIFE-CYCLE AND BREEDING PLACES OF THE COMMON HOUSE-FLY (*MUSCA DOMESTICA*, Linn.)

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This paper is reprinted, by kind permission of Dr. E. W. Hope, Medical Officer of Health, from the preliminary report issued by the Health Committee of the City of Liverpool, 3rd October, 1907. Some additional facts regarding the habits of the house-fly have been obtained recently, but it has been thought desirable to embody these in the final report, together with the results of further experiments with insecticides, disinfectants, and other methods of control.

"This investigation was conducted chiefly with the view of ascertaining the nature and extent of the breeding places of the common house-fly (*Musca domestica*) in the City of Liverpool; and also the period of the life cycle of the fly under varying atmospheric and other conditions; so that some practical measures might be devised for the destruction of this pest.

"In addition to the common house fly, other species of flies also occur in dwellings and shops, and several species were bred from ash-pit refuse, human excreta, &c. One of these, the common blow-fly, or blue-bottle (*Calliphora erythrocephala*), may also prove to be a very important contributory factor in the spread of zymotic diseases, but it is intended, for the sake of clearness, to deal with these additional species in the Appendix to this Report.

"In the popular mind the term 'house-fly' is applied to almost all kinds of two-winged flies which are commonly met with in the dwellings of man. To the zoologist, however, there is but one true house-fly, and this is the *Musca domestica* described by Linnaeus in 1758. This fly is by far the commonest species met with, and quite 90 per cent. of the flies which infest houses in Liveprool are of this kind.

"Altogether, the refuse from over three hundred ashpits and bins (chiefly the former) was examined, and 37 middensteads carefully inspected. Human excreta found in the courts and passages were also inspected, and breeding-cage experiments with these and the excreta of domesticated animals were also conducted. The survey was restricted to five areas in different parts of the City embracing, in all, visits to 68 streets.*

"The result of the investigation and survey has proved eminently satisfactory, both from an economic and scientific standpoint. It has led to the discovery of the chief breeding places of the fly, and many new and interesting facts relating to the food of the larval stages have been brought to light; so that we are now in possession of the more important facts relating to the economy of this pest.

"The chief breeding places of the house-fly may be classified under the following heads:—

"1. Middensteads containing horse manure only.

"2. Middensteads containing spent hops.

"3. Ashpits containing fermenting materials.

"Leaving for the present the minor breeding places, we may proceed to consider the chief ones in detail.

"1. Stable middens containing horse manure only, were broadly speaking, found to be the chief breeding places. In the majority of these the larval stages of the house-fly occurred in countless thousands, revelling in the heat produced by fermentation. The adjacent walls often swarmed with newly-hatched flies, and occasionally one also found enormous masses of their eggs (fig. 2), while deep down at the sides, in the cooler portions of the receptacles, the pupa or chrysalis stage occurred in enormous numbers, looking like small heaps or collections of reddish berries. Middens containing a mixture of horse and cow dung were also infected, though to a less extent than those receptacles containing horse manure only. It is important to note, however, that in all cases where fowls (not ducks or geese) were kept and allowed freedom in the yards, relatively few of the earlier stages of the house-fly were found; and whenever present were invariably located in places inaccessible to the fowls. To make certain that the fowls were responsible for so remarkable a diminution of the fly larvae and pupae, a trowel full of these was

* The list of streets and also the nature of the receptacles are here omitted.—R.N.

thrown to some fowls, when they were eaten with as much avidity as if they had been so many grains of wheat. However much, therefore, we may deprecate the keeping of fowls in large towns, we must, from the evidence which has been adduced, consider them as important contributory factors in the destruction of the earlier stages of the house-fly. It should be pointed out, however, that fowls are kept in a very few of the stable yards, so that in the majority of cases the flies go on breeding uninterruptedly, and, so far as one can gather, the larvae and pupae have few, if any, other natural enemies but those already mentioned.

" In one case, where large quantities of a disinfectant (Sharrant's disinfectant powder) were used in the stable, no larvae or pupae were found in the manure, though they were swarming in a mass of waste hops in a separate division of the same midden. Fly larvae were also absent in another instance where chloride of lime had been used freely. However, one is not prepared, at the present moment, to state definitely that the presence of either of these agents had any deleterious effect on the fly larvae, or that they acted as a deterrent; it may have been a simple coincidence, and the matter requires further investigation.

" All types of middensteads were infected—*roofed*, *vaulted* and *open*.

" The photographs (figs. 6-9) submitted with this report will afford some idea of the enormous numbers of the earlier stages of the house-fly which were found in stable manure.

" 2. Only one midden containing warm spent hops was inspected, and this was found to be as badly infested as any of the stable middens. The pupae (fig. 12) were found collected together in large masses, and the larvae swarmed in the warmer parts of the material.

" 3. A great deal of time was given to the inspection of ashpits, and it was found that wherever fermentation had taken place, and artificial heat had been thus produced, such places were infested with house-fly larvae and pupae, often to the same alarming extent as in stable manure. Such ashpits as these almost invariably contained large quantities of old bedding or straw and paper, paper mixed with human excreta or old rags, manure from rabbit hutches, &c., or a mixture of all of these. (See figs. 10, 11.)

" About 25 per cent. of the ashpits examined were thus infested.

"House-flies were also found breeding, in smaller numbers, in ashpits in which no heat had been engendered by fermentation.

"Both open and closed ashpits were infested, but on the whole the flies gave preference to the closed receptacles. On opening the doors of some of the covered ashpits, the flies often came away in hundreds, appearing like bees round a hive. Ashpits which had been previously treated with disinfectants were also infested.

"In addition to the foregoing, there were also other collections of material which afforded temporary breeding places. They are considered under the following heads:—

"1. Collections of fermenting vegetable refuse.

"2. Accumulations of manure at the wharves.

"3. Bedding in poultry pens.

"1. Collections of straw mixed with other vegetable matter and feathers, lying in open spaces in poultry yards, were found to contain enormous numbers of house-fly pupae (fig. 13). The materials had evidently fermented, and had also been lying exposed to the weather for a period of not less than eight weeks.

"2. The large accumulation of stable manure lying at the wharf (Carruthers Street) was swarming with fly larvae, and the flies occurred also in large numbers; so that it is quite evident that a number of the insects hatch before the manure is placed in the barges for transmission to the country. Practically all the manure is badly infested when it reaches the wharves, so that it is important that it should be shipped with as little delay as possible.

"3. The common practice of leaving 'bedding' material (chiefly long straw) in poultry pens (containing ducks, geese, &c.) until fermentation takes place, affords breeding places for house-flies, and such material should be removed at much shorter intervals.

"Temporary breeding places destroyed by speedy removal of refuse:—

"1. Collections of stable manure removed at short intervals.

"2. Ashpits emptied at intervals of 7-10 days.

"3. Bedding in piggeries.

"1. Ashpits emptied at intervals of about 14 days may be considered as temporary breeding places, the period between the removals being too short for the fly to complete its life cycle. Only under very unusual circumstances, where, for instance, a large amount

of fermenting materials are thrown into the receptacle immediately after it has been emptied, would it be possible for the insect to complete its metamorphosis in so short a period. In the majority of cases, therefore, ashpits emptied at such short intervals can only be considered as temporary breeding places.

" 2. Larvae of the house-fly occurred in large numbers in the receptacle used for holding stable manure in the Corporation Yard,* Mill Lane. As the manure is removed from this place every week, it is impossible for the flies to complete their metamorphosis in it.

" 3. 'Bedding' in the 'piggeries' which had been in use for a few days was found infested with fly larvae. The material used as 'litter' was wood chips. This refuse does not lie sufficiently long for the insect to complete its metamorphosis.

" The non-breeding places were:—

" 1. Middens containing excessively moist and non-fermented cow-dung.
" 2. Patent ash bins.
" 3. Refuse in ashpits saturated with water.
" 4. Human excreta lying in courts and passages.

" 1. No trace of house-fly larvae or pupae was found in any of the middens containing cow manure exclusively. The excessive amount of moisture present in this material was evidently unfavourable to the development of the larvae. But in all cases where horse manure was mixed with it, and fermentation had taken place, larvae were present. The admixture of straw with cow manure would produce similar results.

" 2. No house-flies were found breeding in the patent bins, which is due to the fact that they are emptied daily, or at intervals of a few days.

" 3. No house-flies were found breeding in excessively dry refuse, or refuse thoroughly saturated with water and reeking with inky black putrid matter.

" 4. Human faecal matter found lying in the courts and passages was not infected with fly larvae, and no house-flies were bred from such matter. But human excreta found in ashpits (several instances) and stable middens (two cases) were found to be infested.

* It is interesting to note that the bedding material used at this place was sawdust.

"Reference has already been made to the more important materials in which the larvae were found breeding, but no details have been given as to the exact nature of their food. The dietary, so far as one has been able to see, is almost exclusively that of moist decaying vegetable matter. Horse manure and spent hops were most favoured; but they revelled also in rotten flock beds, straw mattresses; they thrived on old cotton garments and rotten sacks, and waste paper; and seemed especially partial to the dirty beddings from rabbits and guinea pigs. They fed also on bread, decayed fruits and vegetables, the excreta of domestic fowls and pigs, and on human excreta in the ashpits and stable middens. In all cases, however, they thrived best and occurred in the greatest profusion where fermentation had taken place, so that the temperature of the habitat was raised above that of the outside air.

"Like nearly all its congeners, the house-fly undergoes a complete metamorphosis, in which there are *four* well-marked stages; these stages in the life cycle are:—

"1. The egg (ovum), commonly known as 'fly-blows.'

"2. The larva or maggot stage.

"3. The pupa or chrysalis stage.

"4. The imago, or perfect fly. (The final stage.)

"1st Stage.—*The eggs* are laid in small irregular clusters, or in large collective masses* (figs. 1, 2) consisting of many thousands of individual eggs. They are almost invariably deposited on or in such substances as will provide food for the larvae or maggots. They are usually placed in narrow crevices near the surface, but, occasionally, also at a distance of from four to six inches below the surface, the *favoured spots* in all cases being fermenting vegetable matter or the refuse lying immediately over such materials, or in refuse that is likely to ferment. They are often laid, however, on materials which do not ferment, and in all such cases (in this country, at least) the developmental cycle is greatly prolonged.

"The eggs are pure white, and present a highly polished surface, due to the clear, viscous substance with which they are coated. The form of the egg may be seen on referring to the micro-photographs

* I have witnessed as many as 78 females laying their eggs in one small area, the flies being closely packed together. When disturbed they flew away, but returned again to the same spot in a few minutes.—R. N.

(figs. 3, 4), and the actual size is shown in fig. 1. The larvae or maggots hatch from these in periods varying from eight hours to three to four days; the average time may be given as twelve hours, but when laid in fermenting materials the incubation period is reduced to a minimum of eight to twelve hours.

"The number of eggs laid by a single fly averages from 120 to 140. More than one batch may be laid during the life of the fly, but this question has not been definitely settled.

"2nd Stage.—*The larva or maggot* (fig. 9) resembles that of the common 'bluebottle-fly,' or 'Blow-fly' (*Calliphora erythrocephala*), but is much smaller, measuring when fully matured nearly half an inch in length, and is distinguished also by certain anatomical characters. It is essentially a vegetable feeder; animal matter is eaten only, so far as one has been able to gather, when in the form of human faeces. It was never found feeding on the carcases of dead cats and dogs or of birds and fish remains.*

"They thrive and mature most rapidly, and are always most abundant in fermenting materials; but they can also mature in non-fermenting substances during warm weather, though under such conditions they do so very slowly. In stable manure they are generally most numerous a few inches below the surface, and undoubtedly work their way upwards day by day into the fresh material, a few hours (five to six) after it has been added to the previous accumulation. This marked habit is evidently due to the excessive heat which is engendered in the lower strata of the manure.

"Under the most favourable conditions as to temperature and food supply they mature in five to eight days; but, where fermentation does not take place, this stage, even in hot weather, may be prolonged to several weeks (six to eight). In middensteads the fully matured larvae crawl away to the sides or to the top of the wall or framework of the receptacle; in ashpits they locate themselves in various materials as well as ashes, but are evidently partial to old bedding, paper and rags, usually in or near the centre of fermentation. After emptying the alimentary tract of organic matter, pupation takes place rapidly, and the third stage is reached.

"3rd Stage.—The pupa or chrysalis (figs. 7, 10, 11) is at first of a pale yellowish colour, but rapidly changes to bright red, and finally to a dark chestnut colour. It is somewhat barrel-shaped, and varies

* Taschenberg in 1880, states that he found eggs on the carcases of dead animals, but does not indicate that the larvae will breed in such substance.—R. N.

in length from $\frac{2}{12}$ - $\frac{3}{12}$ of an inch. Small examples are found where the temperature has been low or excessively hot and somewhat dry. Large examples invariably occur in fermented materials, more especially so in stable manure.

" In stable middens the pupae occur chiefly at the sides or at the top of the wall or framework of the receptacle, where the temperature is lowest. In such situations they were often found packed together in large masses numbering many hundreds (see figs. 6, 7). The flies emerge from the pupae, under the most favourable conditions, in five to seven days. In ashpits they occur in the positions already indicated, and if similar conditions as to heat prevail, the period is approximately the same; but in all cases where heat is not produced by fermentation, the pupal stage may last from 14 to 28 days, or even considerably more.

" 4th Stage.—The perfect fly escapes from the pupa by breaking away the anterior end; this it accomplishes by inflating the frontal sac, which is situate in the front portion of the head, between the eyes. By the inflation of this sac, the fly is also enabled to force its way through the manure or ashes into the open air. When once it has liberated itself, the wings develop, and when the integument has sufficiently hardened the fly takes to wing. Pairing then takes place, eggs are laid, and another generation is started. The whole cycle from egg to perfect insect occupies, under the most favourable conditions, from ten to fourteen days; but in low temperatures the whole cycle may extend to several weeks. No growth takes place after the wings are developed.

" That the flies migrate from their breeding places to man's dwellings is quite evident, even to the layman, the primary object being apparently to obtain food and shelter. Many flies are also found in such places during winter and early spring, though whether they pass the winter entirely in this stage one has not yet been able to ascertain. It is highly probable, however, that some pupae* may remain over the winter and hatch in the following spring. Now that the breeding places have been discovered, it will be a comparatively easy matter to ascertain if this is the case or not.

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* A single pupa evidently of the house-fly was found during the winter months, but this unfortunately did not produce a fly in the following year.

"Little need be said as to the food of the fly itself, as every layman is conversant with the feeding habits of this little filth-carrying insect. But the contributory part which many authorities have claimed that this insect plays in the transmission of zymotic diseases is due to the almost persistent habit it has of feeding or alighting upon human excreta.

"In the course of my investigations, more especially on hot days, numbers of house-flies were seen hovering over or feeding upon such matter. The faeces were generally those of children, and were lying, as a rule, a few feet from the doorways in the courts or in the passages behind the houses. In one instance no less than five patches of human excreta were lying in one court, and all of these were attended by house-flies.

"Temperature, as has already been stated, has a most marked effect upon the developmental cycle of the fly; and a sudden check from heat to cold will materially prolong any one of the stages. Eggs hatched in eight to twelve hours in a temperature of from 75° to 80° F., at a temperature of 60° F. in twelve hours, but at 45° F. they did not hatch until the third day, and then only when placed in a warmer temperature for the purpose of studying them under the microscope. The larvae or maggots mature in the shortest period in fermenting materials at a temperature of between 90° and 98° F., but they usually leave the hotter portions of the stable manure when it reaches a temperature of 100° to 110°. At 54° F. both larval and pupal stages are considerably prolonged; larvae kept at this temperature had not matured at the end of eight weeks, and a number of pupae kept under similar conditions did not produce flies until the fourth and fifth weeks.

"In this Report I have endeavoured to show that:—

"I.—The chief breeding places of the house-fly are:—

"(A) Stable middens containing fermenting horse manure or a mixture of this and cow dung;

"(B) Middens containing fermenting spent hops; and

"(C) Ashpits containing fermenting vegetable matter, or about 25 per cent. of the total number of pits examined.

"II.—That covered ashpits and middens were as badly infested as those which were open.

"III.—That house-flies breed in all temporary collections of fermenting matter.

"IV.—That house-flies breed in relatively small numbers in ashpits where no fermentation takes place.

"V.—That they do not breed in ashpits which are *emptied at short intervals*, or in the *patent bins*.

"VI.—That the use of disinfectants in ashpits does not prevent the flies breeding in such receptacles.

"VII.—That very dry or excessively wet ashes or moist cow dung* does not harbour them.

"VIII.—That the presence of fowls (not ducks or geese) which had free access to the stable middens reduced the number of larvae and pupae to a very marked extent.

"IX.—That the life cycle of the fly, in all kinds of fermenting materials, is reduced to the minimum period of ten to fourteen days; and that in the absence of such artificial heat the cycle may occupy a period of from three to five weeks or more, according to the temperature of the outside air.

"X.—That house-flies do not depend entirely upon excessively warm weather for breeding purposes, though in hot seasons they would breed much more rapidly in non-fermenting materials, and their numbers, under such conditions, would be greatly increased.

"If house-flies are to be reduced to a minimum, I would . . . . submit the following suggestions . . . . . .

"1. That stable manure and spent hops should not be allowed to accumulate in the middensteads during the months of May to October inclusive, for *a period of more than seven days.*

"2. All middensteads should be thoroughly emptied and carefully swept at the period stated in 1.

"The present system of *partly emptying* such receptacles should in all cases be discontinued.

"The walls of middensteads should also be cemented over, or, failing this, the brickwork should be sound and well pointed.

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* In excessively hot summers cow dung may form a breeding place for the house fly. The admixture of a large quantity of bedding (straw or sawdust), would also render it suitable for breeding purposes.

"3. That all ashpits should be emptied, during the summer months, at intervals of not more than ten days.

"4. That the most strenuous efforts should be made to prevent children defaecating in the courts and passages; or that the parents should be compelled to remove such matter immediately; and defaecation in stable middens should be strictly forbidden. The danger lies in the overwhelming attraction which such faecal matter has for house-flies, which latter may afterwards come into direct contact with man or his foodstuffs. They may as Vedeer* puts it, 'in a very few minutes . . . load themselves with dejections 'from a typhoid or dysenteric patient, not as yet sick enough to be 'in hospital or under observation, and carry the poison so taken up 'into the very midst of the food and water ready for use at the next 'meal. There is no long roundabout process involved.'

"5. Ashpit refuse, which in any way tends to fermentation, such as bedding, straw, old rags, paper, waste vegetables, dirty bedding from the 'hutches' of pet animals, &c., should, if possible, be disposed of by the tenants, preferably by incineration, or be placed in a separate receptacle so that no fermentation could take place. If such precautions were adopted by householders, relatively few house-flies would breed in the ashpits, and the present system of emptying such places at longer intervals than, say, four to six weeks, might be continued.

"6. The application of Paris Green† (poison) at the rate of 2 ozs. to one gallon of water to either stable manure or ashpit refuse will destroy 99 per cent. of the larvae. Possibly a smaller percentage of Paris Green might be employed with equally good results.

"One per cent. of crude atoxyl in water kills 100 per cent. of fly larvae.

"The application of either of these substances might, however, lead to serious complications, and it is very doubtful whether they could be employed with safety. Paris Green, at the rate of 1 to 2 ozs. to 20 gallons of water, is used largely as an insecticide for fruit pests. It does no harm to vegetation when applied in small quantities; but cattle might be tempted to eat the dirty straw in manure which had

* M. A. Vedeer, M.B. 'Flies as spreaders of sickness in camps.' Medical Record, Vol. LIV (1898), pp. 429-430.

† This substance is a definite chemical compound of arsenic, copper and acetic acid.

been treated with this substance, and the results might prove fatal if large quantities were eaten.

"7. The use of sun-blinds in all shops containing food which attracts flies would, in my opinion, largely reduce the number of flies in such places during hot weather. Small fruiterers' and confectioners' shops, as a rule, are not shaded by sun-blinds, and in their absence flies literally swarm on the articles exposed for sale.

"8. The screening of middensteads with fine wire gauze would, undoubtedly, prevent flies from gaining access to manure, &c., but it is very doubtful if this method would meet with any marked success. The gauze would rapidly oxidise, the framework supporting it would probably warp, and numbers of flies would be admitted whenever the receptacle was opened. Moreover, the erection of such a structure would prove a great inconvenience and a hindrance to the removal of the refuse. This, however, does not prejudice the possibility of erecting a good fly-proof screen in the future.

"Experiments with crude carbolic acid, cresylic acid, &c., are being conducted, and the results will be reported later.

"In the introductory remarks on the house-fly, reference has been made to other flies which were found frequenting houses, or were bred from refuse and excreta during the course of investigation. The following is a list of the insects, together with short notes on their habits and prevalence:—

"1. *Calliphora erythrocephala*. The 'Blow-fly.'

"In some parts of Liverpool this fly is quite as abundant as the house-fly, and, like the latter, may, from its disgusting habit of feeding upon faecal matter, also act as a contributory agent in the spread of zymotic diseases.

"This fly feeds upon the faeces of man to a greater extent than the house-fly; moreover, it is also partial to fruits of various kinds, especially over-ripe plums and grapes and dried figs and dates, so that one can readily conceive how it would be possible for the flies to mechanically transmit the germs of disease from faecal matter to fruit, and as a large percentage is eaten uncooked, the transmission of infected faecal matter, if present, would be direct.

"The female insect lays its eggs in all kinds of raw and cooked meat, the carcases of mammals, birds, fish, &c., and wherever such remains were found in ashpit refuse, the larvae of this insect swarmed.

"2. *Scatophaga stercoraria.* 'Dun' or 'Yellow Cow Fly.'

"This is a rather large yellow fly which abounds in the country, but is relatively scarce in the city of Liverpool. It breeds in cow dung, and was occasionally seen in some of the middens. It rarely enters houses, and is therefore of no economic importance.

"3. *Borborus equinus.*

"A minute fly which literally swarms in stable manure all over the city. As it rarely enters houses or shops, it is of no economic importance. Fowls eat large numbers. It breeds in the faeces of the horse.

"4. *Stomoxys calcitrans.* 'The Stable Fly.'

"This is a blood-sucking insect, and is one of the recognised carriers of Trypanosomiasis in tropical countries. In 1906 it was common in some parts of Liverpool, but this year it has been quite scarce. It breeds in fermenting horse manure and grass mowings. It sometimes enters houses and bites both man and his domesticated animals. Of little economic importance in Liverpool.

"5. *Homalomyia canicularis.*

"This species is often common in the dwellings of man, and is for this reason often mistaken for the house-fly. In Liverpool, however, it is by no means abundant, and not more than one per cent. of the flies captured in fly-traps are of this species. It breeds in horse manure, and possibly also in the faeces of other animals.

"6. *Anthomyia radicum.* 'Root Fly' or 'Root Maggot.'

"Closely related to the foregoing species, but not common in Liverpool. A few examples were captured in fly-traps; but no specimens were bred from refuse of any kind.

"7. *Homalomyia scalaris.*

"The larvae of this species were frequently seen in ashpit refuse; and a number of these flies were bred from human faeces. It is not a very abundant species, however, and so far as my investigations have gone, it has not been found very often in houses or shops. The larvae feed on all kinds of faecal matter, and are especially partial to human excreta; they revel in privies, often congregating together on the shield board in hundreds. Cases of intestinal myiasis in man have been attributed to the larvae of this fly.

"8. *Psychoda (?) phalænoides.* 'Owl Midge' or 'Moth Fly.'

"A minute moth-like insect often seen on window-panes in houses. The larvae of this insect were common in human faeces, and many examples of the flies were bred from this material. It is also common in putrid sewage matter. May be looked upon more in the light of a scavenger, but is of little or no economic importance.

"9. *Coleoptera.* (Beetles.)

"Two species were particularly common in ashpits, viz., *Creophilus maxillosus* and *Philonthus politus.* They act as scavengers, feeding upon all kinds of débris. They rarely enter houses."

FIG. 1. FOUR BATCHES OF EGGS. NATURAL SIZE

FIG. 2. COLLECTIVE BATCHES OF EGGS IN STABLE MANURE, NUMBERING ABOUT 1,500. NATURAL SIZE

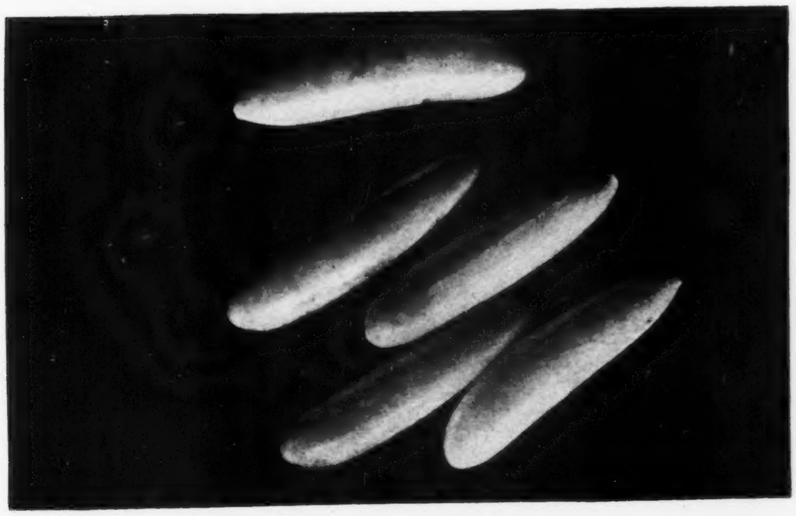

FIG. 3. EGGS ENLARGED

*R. Newstead—Photo.*

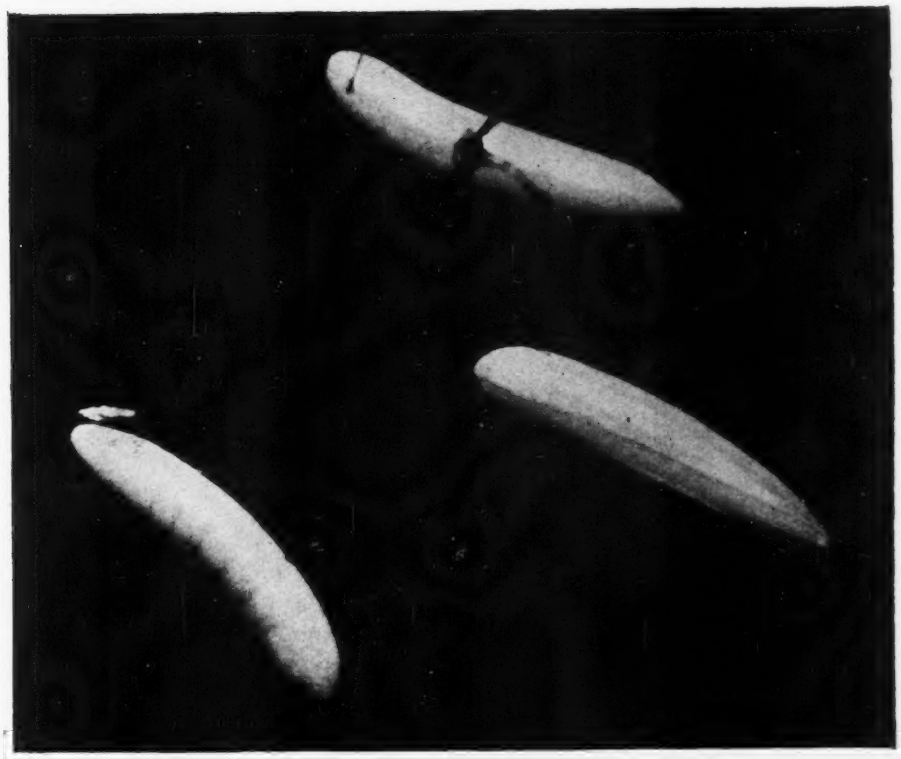

FIG. 4. EGGS GREATLY ENLARGED; ONE SHOWS THE SEGMENTS OF THE LARVA THROUGH THE CUTICLE

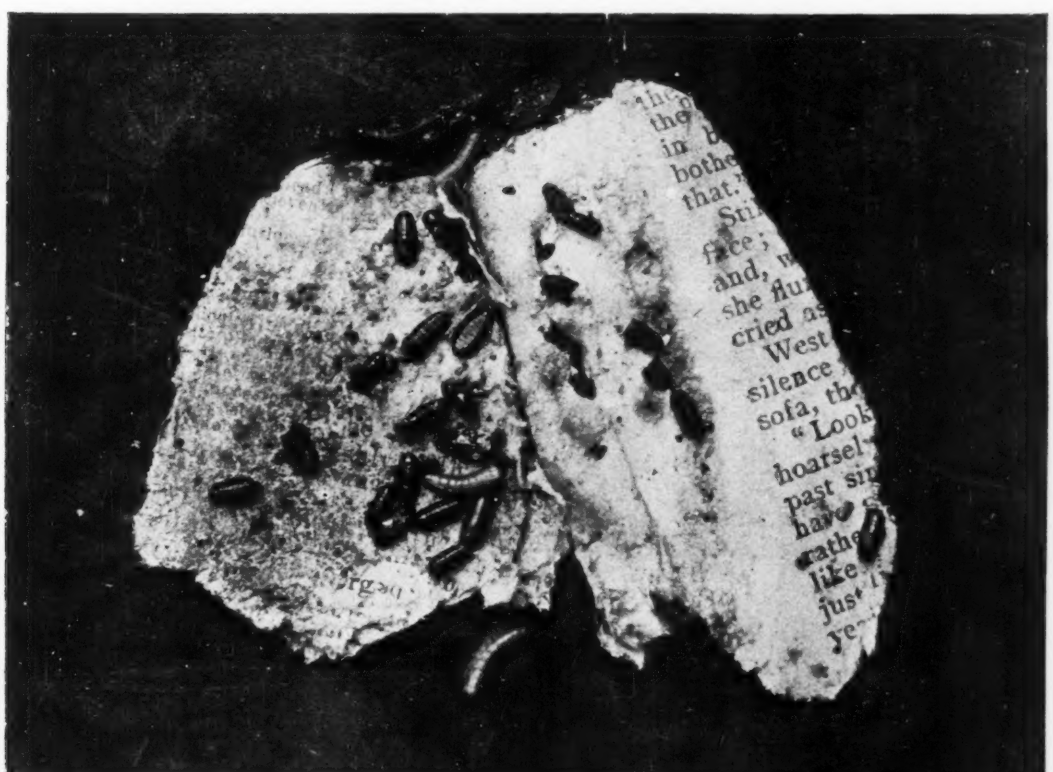

FIG. 5. LARVÆ AND PUPÆ IN WASTE PAPER (ASH-PIT REFUSE). NATURAL SIZE

*R. Newstead—Photo.*

FIG. 6. MASS OF ABOUT 200 PUPÆ IN STABLE MANURE.
NATURAL SIZE

FIG. 7. MASS OF PUPÆ SEPARATED FROM STABLE MANURE SHOWN IN FIG. 6.
NATURAL SIZE

R. Newstead—Photo.

FIG. 8. MASS OF LARVÆ IN STABLE MANURE. NATURAL SIZE

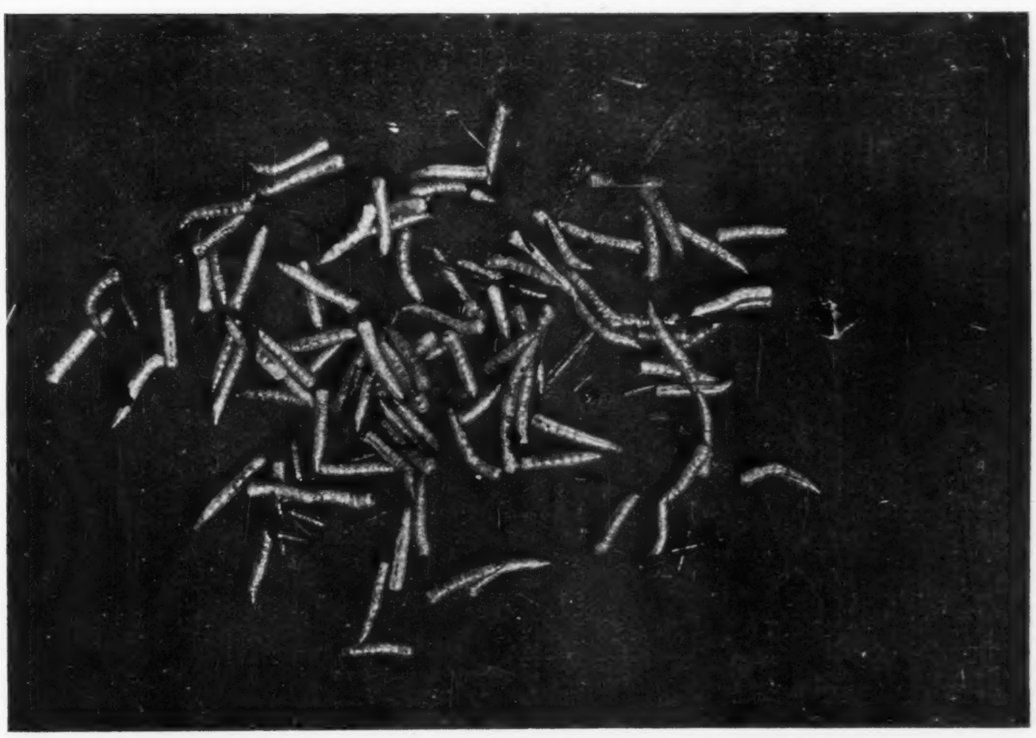

FIG. 9. MASS OF LARVÆ SEPARATED FROM STABLE MANURE SHOWN IN FIG. 8. NATURAL SIZE

R. Newstead—Photo.

Fig. 10. LARVÆ AND PUPÆ IN OLD "FLOCK" BEDDING.
NATURAL SIZE

Fig. 11. LARVÆ AND PUPÆ IN OLD RAGS (ASHPIT REFUSE).
NATURAL SIZE

*R. Newstead—Photo.*

FIG. 12. MASS OF PUPÆ IN SPENT HOPS. NATURAL SIZE

FIG. 13. PUPÆ IN FEATHERS AND STRAW, FROM POULTRY YARDS. NATURAL SIZE

*R. Newstead—Photo.*

# SOME NOTES ON THE MORPHOLOGY OF *SPIROCHÆTA DUTTONI* IN THE ORGANS OF RATS

# SOME NOTES ON THE MORPHOLOGY OF *SPIROCHÆTA DUTTONI* IN THE ORGANS OF RATS

BY

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*From the Runcorn Research Laboratories*

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The strain of *Spirochæta duttoni*, brought from the Congo by Dutton and Todd, is maintained in the Runcorn Research Laboratories through inoculation of infected blood from rat to rat. By Levaditi's[1] silver method I have investigated the morphology of the parasites in the organs of some of these animals killed at different stages of the infection.

The principle of the silver method may be briefly stated as follows:—The organs, after fixation in formol, are impregnated with a solution of silver nitrate, and then exposed to the reducing action of pyrogallic acid. In thin paraffin sections the tissues appear of a bright yellow colour, with sufficient differentiation of the nuclei; the spirochaetes black, with sharply defined outlines. To bring out the relation of the parasites to the tissues, Giemsa's or other stain may be employed.

The pyridin-silver modification, the 'second method' of Levaditi, gave generally good results, not only with fresh material, but also in organs which had been kept for some months in formol.

Details of the course of experimental spirochaete-infection in rats may be found in the extended study of Breinl and Kinghorn;[2] here it is only necessary to repeat that the maximum number of parasites in the peripheral circulation is reached on about the fifth day after inoculation, after which the spirochaetes disappear rapidly and completely, until the first relapse, which occurs in about a week and extends over one to three days.

Examination of sections (4 to 6$\mu$) of the organs of rats, killed at the height of the infection, shows the large and small blood-vessels and capillaries crowded with spirochaetes, in accordance with the observations of Levaditi.

The outlines of the parasites are best seen in the capillaries of the lung and liver, whereas in sections of the heart and large blood-vessels the spirochaetes are generally found massed in broad strands. In the spleen at this stage a different condition is observed; the parasites being comparatively few in number, and mostly intracellular.

The shape of the spirochaetes is not everywhere the same; characteristic organisms, showing regular spirals, being generally seen in lung and heart; while the liver and the spleen contain atypical forms, which can be recognised only by their staining reaction, and by the conditions under which they are found and by the presence of intermediate stages. These forms are seen as small, circular or oval, tightly-coiled spirals, about half the size of a red blood-cell.

Similar forms have been described and figured by Breinl and Kinghorn. These authors found "occasionally in films made from the liver and the spleen spirochaetes coiled up into a small compass, staining a deep red with Giemsa's stain, and surrounded by a well-stained membrane." Levaditi has also observed them as occurring in the liver of mice, and discusses their probable nature in the light of similar appearances met with by himself, Manouélian, Cantazucène, v. Prowazek,[3] Schaudinn, and other authors, in the spirillosis of fowls. He interprets them as agony-forms, preceding further stages of degeneration and disintegration. v. Prowazek, on the contrary, considers these bodies as "resting stages" in the life cycle of the parasite.

With regard to this interesting question, I may state that these forms occur in by far the greatest numbers in the liver, less numerously in the spleen, scantily in the lung, while in sections of the heart-blood they could not be demonstrated with certainty.

Moreover, very few, if any, have been observed free in the lumen of the capillaries, the majority being easily demonstrated in phagocytes.

These two facts—the excessive disproportion in the number of these altered forms found in the liver, and their approximately constant relation to phagocytes—seem to afford a strong argument in favour of Levaditi's hypothesis.

Observations were also made at the crisis of the disease. Breinl and Kinghorn have already pointed out the difficulty of determining this period. In one case described by these authors, the disappearance

of the parasites from the peripheral circulation occurred between 2 and 5-30 a.m.

In the present case, material at this period was obtained with less difficulty. A rat (1,540 B) inoculated on July 20, 1907, showed very numerous parasites in thick films of tail-blood on the morning of July 25. It was examined five hours later, when the parasites were found to have disappeared almost entirely from the peripheral circulation; the animal was then killed for the purpose of examining the organs at the stage of crisis.

Very few spirochaetes were observed in the vessels and capillaries of lung and kidney. The spleen showed a moderate number of large phagocytes containing partly digested and fragmented spirochaetes. In the liver, on the contrary, the capillaries were crowded with parasites, or, to be more exact, were nearly or quite occluded by swollen mononuclear phagocytes—endothelial cells and cells of Kupfer—filled with innumerable black granules, many coiled forms and only a few normal spirochaetes.

This observation seems to lend additional support to the hypothesis that the coiled forms are due to the influence of phagocytosis. At the height of the infection the vessels of the different organs were crowded with free, apparently unaltered spirochaetes, and the liver showed in addition a great number of intracellular coiled forms; at the crisis the extracellular parasites had disappeared almost entirely, and in the liver were found, besides the cell-included coiled forms, large numbers of fragmented parasites and granules, evidently products of intracellular digestion.

The occlusion of many of the capillaries of the liver by swollen phagocytes seems to account for the hemorrhagic and anaemic infarcts observed by Breinl and Kinghorn. Levaditi is also inclined to explain the changes observed by him in the liver of infected mice, by obstruction of the blood-vessels of this organ.

## BIBLIOGRAPHY

1. LEVADITI ET MANOUÉLIAN. Recherches sur l'infection provoquée par le spirille de la 'Tick-fever.' Annales de l'Inst. Past., 1907, XXI, p. 295.
2. BREINL AND KINGHORN. An Experimental Study of the Parasite of the African Tick-fever (*Spirochaeta duttoni*). Memoir XXI of the Liverpool School of Tropical Medicine, September, 1906.
3. v. PROWAZEK. Morphologische und entwicklungsgeschichtliche Untersuchungen über Hühnerspirochaeten Arbeit. a. d. kaiserl. Gesundheitsamte, XXIII, 1906. S. 554.

MALARIA AND HISTORY

# MALARIA AND HISTORY

BY

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It seems likely that disease has exercised considerable influence upon the history of mankind. In the struggle for existence, man, by his intelligence, has long since removed wild beasts from the number of his competitors. In civilised parts of the world, at least, the struggle is now limited to competition with his fellow-men and with the parasites of disease. The study of man's combat with man is history as at present understood; the antagonism of man and parasites may prove to be equally important. Although the biological study of disease is still in its infancy, the time has come to collect material, and by careful induction to try to discover any laws which may appear to have a temporary validity. Furthermore, it is well so to limit the investigation as to explore more thoroughly a narrower field before attempting to draw wider inferences or to formulate more general laws.

The effects of endemic disease are easier to investigate than those of epidemics, because the influence exerted is continuous, and spread over a long period. For a similar reason the question is better studied from the historical side than by a consideration of the present state of countries where disease is endemic; although, of course, the latter method will furnish valuable information of which use must be made. Among endemic diseases, malaria, from its wide extension, the large percentage of a people attacked by it, and its long history, appears to afford the best starting-point for the enquirer.

Convinced of the truth of the above statements, the writer began to enquire whether malaria played any part in the history of ancient Greece and Rome, the decline of which is generally thought to have commenced during the fourth century B.C. in the case of the former, and in the second century B.C. in the case of the latter. The suggestion had already been made by Major R. Ross, but there was

practically no previous literature on the subject, as the valuable paper by Professor Aristotle Kouzis, *τινὰ περὶ ἑλειογενῶν πυρετῶν*, Athens, 1907, had not yet appeared. On the other hand, the ancient literature containing references to malaria was of immense size, and none of it could safely be neglected. The means used to identify malaria in ancient literature were as follows:—

(1) Tertian and quartan fevers are almost certainly malaria.
(2) Quotidian fevers are very likely malaria.
(3) Enlargement of the spleen and early autumnal fevers very often mean malaria.
(4) Fever in marshy districts is probably malaria.

Of course the ancients knew nothing about microscopes and the action of quinine.

## MALARIA IN GREECE

There is an early reference to *πυρετὸς* in Homer, but the word means there, in all probability, "heat" not "fever." The only other possible reference in early times is in Theognis, who lived about 540 B.C. at Megara. He talks in one passage of *ἠπίαλος*, which certainly in later Greek often means ague. In a recent volume, however, of Pauly-Wissowa's Classical Encyclopaedia, it is suggested that this word was originally connected with the nightmare demon. In that case Theognis may be referring to the fright-rigors of nightmare, and not to malaria.

It is important to notice that Hesiod, the Boeotian poet, does not mention malaria as one of the farmer's plagues, though we can be certain that he would have done so had the disease existed. Boeötia is now highly malarious, but in very early times just those places in it were chosen for habitation which are most unhealthy at the present day. Surely malaria cannot have been in this district from prehistoric times. It is true that Suidas quotes *ἐπιάλτης* from some lost work of Hesiod, but although this word is said to mean ague in later Greek, it certainly meant nightmare at first.

In the Hippocratic writings, which may be placed approximately between 450 and 350 B.C., all the "tests" of malaria given above are mentioned again and again, and it must not be forgotten that these writings certainly imply a long tradition behind them. Accordingly, in the Eastern parts of Greece, the home of the doctors who wrote

these traditions, malaria was probably known as early as 500 B.C. If so, it may have come from the East, and malaria is frequently mentioned in the Sanscrit writings. (See Jolly, *Grundriss der Indo-Arischen Philologie und Altertumskunde, medicin*, p. 72.)

But, if the literary evidence can be trusted, the disease did not appear in Attica before 450 B.C., became more common during the period 430-400, and finally was so wide-spread as to be designated in the common speech, though not in the medical writings, by the words *πυρετός, πυρέσσω,* without further qualification. Every medical writer after Hippocrates mentions malaria in the clearest possible language. Even the remittent forms are discussed, although at first the Greek physicians seem to have been often unable to distinguish remittent from continuous fevers—a fact not to be wondered at when we remember that thermometers did not yet exist. Double and mixed infections were recognised after a while, and Major Ross believes that in the "semi-tertian" we are to see the double malignant tertian. Malarial cachexia, with its attendant evils, splenomegaly, anaemia and dropsy, is described again and again, usually in connection with marshy places. "Fever" is often ascribed to over-fatigue, and it is well known that in a highly malarious country exertion will usually precipitate an attack. Typhoid, clear descriptions of which are curiously lacking in the ancient medical writings, generally takes in them a malarial form, exhibiting tertian periodicity without the peculiar characteristics of typhoid, diarrhoea and rose-coloured spots, while pain in the region of the liver is far more common than in ordinary forms of the disease. Now typhoid often assumes this form in malarious districts, as the doctors of the non-malarious North discovered when, in the American Civil War, they treated patients in the malarious South.

In the non-medical writers malaria is mentioned many times, though not so often as in Latin literature. I can find clear references in Sophocles, Aristophanes, Plato, Aristotle, Demosthenes and the inscriptions.

It is quite impossible, in the absence of direct testimony, to say when malaria first came into Greece. But the fact that *πυρετός* in the sense of "fever" does not occur before the time of Hippocrates, combined with the probability that at first older people were frequently attacked, makes it likely that the disease did not become

endemic, at least in Attica, until the close of the fifth century B.C. But although we cannot date its introduction, it is quite certain that it became more common after 400 B.C., until a Greek could talk of his touch of fever in much the same way as we talk of influenza, or an ordinary cold. Nor did malaria change its type. From Hippocrates to Joannes, from the fifth century B.C. to the fourteenth century A.D., malaria is described in almost precisely the same terms, and with exactly the same symptoms, and these symptoms are so clear that we can recognise all the various forms of the disease as we meet them at the present time.

## MALARIA IN ITALY

When and how malaria was introduced into Italy, or when it became endemic there, is a very complicated question. It is generally assumed, e.g. by Celli, that malaria was common in pre-historic times, and that the drainage works at Rome were intended to diminish the disease, while Cicero is quoted as putting on record that Romulus founded a city in a healthy spot surrounded by an unhealthy neighbourhood. It is quite possible that even in early times the disease did exist, but if this be so, it cannot have been severe, nor can it have been widely spread. For it is certain that some districts, the most highly malarious in the historical period, were flourishing centres in early times, and could not have been, as is, indeed, generally acknowledged, very unhealthy. On the other hand, if the drainage scheme carried out by the kings improved the health of the city, this improvement did not last, for the Rome of the early Empire was so malarious that it was considered very dangerous to remain in it during the autumn months. It may be concluded that Italy did not suffer much from malaria before 200 B.C., that after that date it gradually became more common, as is proved by references to it in literature, until, during the early Empire, many country districts, and also Rome itself, suffered most severely from the disease in an endemic form. The evidence that Rome was highly malarious at the beginning of the Christian era is overwhelming; the more I study the question, the plainer it becomes that the disease exerted a marked influence upon the life of every inhabitant. The poet Horace refers to malaria at least six times, and there are five references in Martial, including three to the deadly

semi-tertian. Horace speaks in the most casual manner of the foolishness of holding out against the disease until the trembling-fit causes disaster at the dinner-table. All who could do so left Rome in the summer, but the poorer people must have suffered severely, as they appear to have slept very often in booths, or open places, thus offering themselves as easy victims to the mosquito. Dropsy, a frequent result of malaria, seems to have been extremely common. Horace says that a man who will not take exercise will certainly fall a victim to it, just as we might say that a sedentary occupation must cause liver-trouble.

Here I should like to meet a possible objection. If malaria was introduced late in the history of Greece and Rome, why have we no mention in ancient writers of the time when it first made its appearance? But it must be remembered that on its first introduction malaria would certainly be confused with other fevers (typhoid, for instance) already existing in the country. In fact even now some kinds of malaria are so like typhoid that the microscope alone can distinguish between them. It would be only after some time that malaria could be recognised as a separate disease, and as late as Galen there is much confusion between the remittent forms and other pernicious fevers. But in the case of Italy there is very likely a reference in the historian Livy to the time when malaria first became widely spread over the country. He says that in the year 208 B.C., an epidemic occurred which did not result in many deaths, but caused much lingering sickness. This looks like an epidemic of malaria, and it should be noticed that the date is within the period of the Hannibalic War, when the land was laid waste and favourable conditions were given to the mosquito. On other grounds also, mentioned in this paper, it seems likely that malaria became common about 200 B.C.

The malarial fevers of Greece and Italy were not confined to the regular types. Besides the malignant forms included under the heading "semi-tertian," many other dangerous kinds are distinctly mentioned. In two books of the Hippocratic *corpus*, *Prorrhetics* and *Prognostics*, there are frequent references to blackwater fever, the algide, hyperpyrexial, comatose and other cerebral forms. Again and again mention is made of aphasia, loss of memory, deafness, convulsions and amblyopia as symptoms of certain kinds of malarial

attacks. It is difficult to discover how far these forms were common in Rome, owing to the way in which Roman writers on medicine repeated the remarks of their Greek predecessors, but we are distinctly told that the semi-tertian was extremely prevalent.

Both in Greece and in Italy the geographical conditions favour the development of malaria, as is proved by the prevalence of the disease in modern times. But, for the present discussion, attention must be paid to the neighbourhood of Athens and Rome. Near Athens were two streams, the Cephisus and the Ilissus, which, by partially drying up in summer, favoured the rapid growth of the mosquito. Near the Piraeus was a marshy district which must have proved a continual focus of malaria. Besides these natural breeding-places, the cisterns in which the Athenians kept their water seem to have harboured mosquito larvae. Aristotle tells us that they often contained the larvae of an insect which was, in all probability, *Chironomus*. The streets also of the city were very muddy in wet weather, so that puddles in out-of-the-way places were certainly numerous. I may refer the reader to four able articles on malaria in Greece, by Drs. Savas and Cardamatis, which appear in the viiith (1907) volume of *Atti della Società per gli Studi della Malaria*. The geographical conditions are shown to be well adapted to the growth of the mosquito.

At Rome similar conditions prevailed. The inundations of the Tiber flooded a considerable portion of the land near its banks, which were notoriously unhealthy. The streets seem to have been as muddy in wet weather as were those of Athens, while the *atrium* of each Roman house contained a pool of rain-water which collected into the *impluvium* through a hole in the roof, intended no doubt, at least originally, to let out the smoke from the household hearth.

It should be noticed that just at the time when malaria appears to have become endemic in Attica and Italy (420 and 200 B.C.), severe wars laid the country waste, and prevented for many years the proper control of irrigating streams and canals. This would favour the spread of malaria.

## INFLUENCE OF MALARIA UPON GREEK AND ROMAN HISTORY

In estimating the effects of malaria upon the history of Greece and Rome several facts must be borne in mind. In the first place the ancients had no quinine; the disease must have run its course without being mitigated by any efficient remedy. It is therefore probable that, in Greece at least, some element of the race was weeded out. This would be the Northern strain to which, in all probability, the Greeks owed their best qualities. Again, the virulent remittent forms of the disease seem to have been particularly common. The poet Martial, whose works make but a moderate-sized volume, mentions the malignant semi-tertian three times. In Hippocrates frequent reference is made to those cerebral forms of malaria which, in the words of Mason, lead to "permanent psychical disturbances." Malarial cachexia, with accompanying derangement of the digestive system, was very common. Furthermore, the extent to which malaria occupies the medical treatises is, to say the least, surprising. By far the greater number of the fever cases in the Hippocratic writings refer to malaria in its intermittent or remittent forms; while in the Latin author Celsus, who flourished about 50 A.D., other kinds of fever are scarcely mentioned at all, so that in his book *febris* is practically equivalent to malaria.

The Greeks themselves seem to have noticed that malaria often produced strange psychological effects. So much is plain from their use of the term μελαγχολία and its cognates, which, in the common speech, denoted that a man was crazy, neurotic or even mad, while they were almost certainly medical terms originally, denoting malarial cachexia, or, sometimes, the epileptic convulsions which are often to be observed during a malarial attack. The problem is made a little complicated by the fact that Greek medical terms rarely coincide exactly with any now in use, a source of confusion against which the historian must be always on his guard. "Melancholy" denoted a good many kinds of bilious conditions; but when it is observed that the Greeks themselves thought that quartans had their origin in "black bile" (μέλαινα χολή), that Galen declares large spleens to be due to excess of the "melancholy" humour, that cases of "melancholy" are said to be common in autumn, it seems practically certain that the word was often used to describe malarial states, and that the Greeks

observed how malaria affects the temper, rendering the patient morose and cross-tempered. It is interesting to note that the word μελαγχολία becomes common in Attic literature just at that time (the last quarter of the fifth century) when it seems likely that malaria first became endemic in Attica. Plato in the *Timaeus* declares that vice is due to bodily disease, and in particular derives peevishness, melancholy, rashness, cowardice, forgetfulness and stupidity from bilious humours finding no outlet from the body.

There is a remarkable reference to the influence of malaria upon character in the Hippocratic treatise *Airs, Waters and Places.* "Those who dwell in hollow, hot districts," says the writer, "where the winds and water are warm, are neither tall nor straight. If they drink the water of the place they have diseases of the spleen and stomach. They are stout and fleshy, dark-coloured and bilious. By nature they are neither courageous nor of great powers of endurance. But there are no ill effects when the water is drained off."

What, then, is the change of character which accompanied the decline of Greece and Rome? Between 450 and 300 B.C. the Greeks (at any rate the Athenians, for it is of them that we know most) lost their manly vigour and intellectual strength. Patriotism was still considered a virtue, but few had the energy and initiative to translate theory into practice. Love of ease and comfort grew apace. Philosophy became pessimistic, and there was much brooding over death. In art there appeared a tendency to sentimentalism. The Greek of the third century B.C. was unequal to the effort for further progress, and never recovered the vital force he once possessed.

In Rome and Italy the change was different. The Roman of the early Empire can scarcely be called weak. But he had changed. His sternness had become brutality. He was no longer contented with a simple life, but loved gorgeous display and magnificent banquets. Furthermore, the population of the city changed. The old Romans, apparently, grew fewer in numbers, for there is a constant lament that families were small, while crowds of foreigners flocked to the imperial city, many of whom rose to power and influence. The armies were often recruited from Spaniards and other more virile stock. Historians and moralists repeated *ad nauseam* the truth that the old Roman spirit was dead.

Now it would be absurd to maintain that all these changes were

produced by malaria. The Greek outgrew his city-state, lost his faith in religion, and exhausted his strength in a series of suicidal civil wars. He practised unnatural vice to an extraordinary extent, and this, with other excesses, produced the natural consequences. But surely these influences must have been aided in their operation by the presence of an insidious foe, which weakened the individual from his birth, and left him an easier victim to the disintegrating forces of his environment.

The Roman also outgrew his institutions, and no longer found satisfaction in political life. The farms, which had bred a strong race of yeomen, gradually gave place to large grazing estates. Corn could be imported from abroad more cheaply than it could be grown at home, and the farmers crowded into the already-congested metropolis. Economic causes, then, as well as political and psychological forces, were at work both in Greece and in Italy during the period of decline. But the fact remains that the Greeks became a race of inefficients, while the Romans of the empire may be roughly divided into two classes—a few luxurious debauchees and a host of debased and poverty-stricken retainers.

It is much to be regretted that scientists have paid but little attention to the effects of malaria upon national prosperity and national character. The economic effects, indeed, are noticed with more or less detail by many observers. Celli in his *Malaria* talks of the loss of labour and production caused by the disease, and Clemow describes the appalling incapacitation and economic loss which accompany its ravages. But its influence upon character has never been thoroughly investigated. North, in his fascinating work *Roman Fever*, does say something on the point, but confines himself to the general statement that a highly malarious district, if left to itself, must contain a population that tends to moral degradation. Professor Nieuwenhuis, of Leyden, who has studied the wild tribes of Borneo more than any other traveller, writes to tell me that in that island malaria actually has the disintegrating effect which I assert it had among the Greeks. The results of his investigations are to be found in his book *Quer durch Borneo.* But there certainly is room for a book containing an adequate study of this question from both the physical and the psychological standpoints. A necessary preliminary to such work seems to be a historical study of the dates

at which malaria was introduced into various districts, and of the effects which followed this introduction. Up to the present our information is very slight, being confined to such instances as the invasion of Mauritius by malaria in 1866.

There is also a pressing need for an investigation into the moral and intellectual characteristics prevalent in highly malarious districts, and a comparison of them with those of neighbouring parts, under similar economic and political conditions, but untroubled by malaria. This is another unworked field for historians. I take it that the effects of malaria are threefold:—

(1) It may kill, or drive away, the inhabitants. There is evidence that the population of Greece gradually declined, and that an inferior race, but one relatively immune to malaria, supplanted in course of time the older population. I hope to publish this evidence shortly.

(2) It may cause physical and mental degeneration by making childhood unhealthy.

(3) It may cause inactivity by punishing over-exertion and fatigue.

The first thing to do will be to collect material, and for some time I have been impressing upon anthropologists the necessity of observing the psychological peculiarities of peoples among whom malaria is endemic. It is probable enough that the lapses into barbarism which so often disgrace Europeans living in tropical countries are at least partially caused by this disease or its *sequelae*. I am told that German officials are forced by the Government to carry quinine with them when they set out for malarious regions of Africa, and the reason assigned is that moral deterioration may follow malaria unchecked by prophylactic measures. Unfortunately, I have been unable to discover from written evidence whether this is correct.

## CONCLUSION

It is certain that both Greece and Italy were, at least in their most important centres, highly malarious during the period of their decline. Whether Athens and Rome were malarious when they were growing in power and greatness it is impossible to state for certain, but the disease was in all probability rare, even if it was present at all. On the other hand, the decline was in both cases accompanied

by an increase of malaria. The change in the Greek character was just that which we should expect malaria to produce in a highly sensitive and cultivated people, while the savage brutality of the later Romans may be due to the same cause. The peculiar effects of a disease on national morality will certainly vary with the prominent national characteristics. The more effeminate Greek grew weak and inefficient; the stern Roman became viciously cruel. But it must always be carefully remembered that other factors, physical and psychological, contributed to the change in both cases. The growth of intelligence, resulting in dissatisfaction with existing institutions; the decay of agriculture or trade; the slow effects of vice and luxury; the exhaustion of the conditions which stimulate a people to aspire to national greatness—all these were doubtless important factors in the decline of Greece and Rome. But malaria gave rise to physical conditions which afforded an excellent opportunity for other influences to produce their full effect. It must also be remembered that these conditions would be reproduced from generation to generation, for malaria was continuously present, apparently increasing until nearly everybody was more or less infected. A temporary disaster, whether it be war or a virulent epidemic, often stimulates to great deeds and heroic actions; but a weakening endemic disease, attacking every fresh generation as it is born, gives the nation which is its victim no chance to recuperate.

In the preceding pages I have indicated very briefly the main conclusions which it seems just to draw from a study of the classical literatures. But only the fringe of the subject has been touched, even within the limited area to which I have confined my own investigations, and a vast field remains to be worked by those who will take the trouble to trace the effects of malaria upon other nations. It is only from a comparison of results obtained in a series of enquiries that any really valuable knowledge can be expected. The influence of diseases other than malaria is also most important, and should be carefully studied. Mr. T. Spencer Jerome, who has for many years paid attention to the biological aspect of history, sends at my request the following note on the transformation of the Roman character. The remark it contains about pestilence killing off those of the greatest nerve force is interesting, as it is just possible that the great Athenian plague of 430 B.C. weakened the general health by attack-

ing and killing those best fitted to be parents of vigorous offspring. It is a fact that the Athenian population was permanently reduced by this epidemic, and perhaps malaria, which appears to have become endemic in Attica soon after 430, found a people already weakened and less able to resist its ravages.

## NOTE

The influence of diseases on historical development will obviously be mainly through their effects in weakening individual nervous systems, and, as a result of this, individual character. Now it seems well established that all infectious fevers play an important part in the etiology of the psychoses and neuroses. Typhoid especially is incontestably a cause of psychasthenia, and often profoundly alters the whole nervous system. So also influenza. The number of severe infectious maladies prevalent throughout Roman history is well known. After the great outbreak of pestilence in the time of Marcus Aurelius, it kept reappearing from time to time for a century or more.

Another point deserving consideration is this:—Is it true that the neurasthenic person is relatively immune to other and more immediately dangerous diseases? Dr. Beard, whose studies of neurasthenia are so well known, asserted this positively—though the explanation he gives seems slightly fanciful.* Dr. V. C. Vaughan, who examined the matter of the typhoid outbreaks in the American army camps at the time of the Spanish war, informed the writer that the fever seemed to select the soundest men. If this be so, then a long continuance of severe infectious maladies would operate not only to produce much nervous debility, but also by a kind of inverse natural selection to eliminate the relatively sound elements in a people.

Now that the biological method of approaching historical problems has been begun, we may hope for real progress, and may cease to rely for explanation of historical developments on hypostatized virtues, vices, institutions and the like. But, as a preliminary step to the application of biology to Roman history, we need to clarify our knowledge of just what were the changes in the average human character of that period, and the order of their development in time. One may well be sceptical as to the extent and accuracy

* Sexual Neurasthenia, by Dr. G. M. Beard, 4th Ed., pp. 63-4, 72-3, 76-8, 116.

of our comprehension of these facts. It is probable that Tacitus, Juvenal and Pliny, as well as most other writers of imperial times, throw more light upon their own character than upon those depicted by them, while our knowledge of early Roman character is involved in an iridescent haze.

T. S. JEROME

CAPRI, ITALY

## PLUTARCH ON HEALTH

Let us see whether the theory put forward in the preceding pages is confirmed by a Greek work which was written about the end of the first century after Christ.

Among the *Moral Treatises* of Plutarch is included a work the Latin name of which is *de tuenda sanitate praecepta.* It is intended for the use of those who devote themselves to study or politics (137 c), and lays down the rules which must be observed by such if they wish to keep in health. At first sight it appears to be a sensible but somewhat commonplace series of remarks; but a more careful reading proves that it throws a flood of light upon the hygienic conditions of the period when it was composed. Before proceeding I will give a short analysis of the contents.

It is necessary to keep the hands warm, as chill in the extremities invites fever (123 A). It is useful to accustom the body when in health to the diet which would be necessary in illness, and it should not be thought insufferable to dine unbathed (123 B—D). The body ought to be nourished, as a rule, with simple foods, so that, should an occasion occur when feasting cannot be avoided, no harm results from indulgence. If some high official invite us, or other imperative call come when we are indisposed, it will be less boorish to abstain than to fall into πλευρῖτις or φρενῖτις through false shame (123 E—124 D).

Food and drink are to satisfy hunger and thirst. Dainties should not be consumed merely because they are costly, or because we wish to boast that we have eaten them. The body must not tyrannise over the soul, nor yet the soul over the body, so as to cause over-indulgence. A man should take a pride in his power to abstain. Rich, tempting dishes cause us to eat too much (124 E—126 B).

Pleasure is impossible without health. We are wont to neglect plain living when we are well, and in sickness to lay the blame upon climate (ἀέρας, χώρας), instead of our own intemperance. When

ill we should say to ourselves that drinking cold water, or an untimely bath, has deprived us of many pleasures. In this way we are made more careful when in health (126 B—127 B).

Granted that fevers are caused by exertion, heat and chill, too much food increases the liability (127 B—D).

The forewarnings given by fever must not be neglected. Some, when they feel an attack coming on, betake themselves to baths and banquets, lest they fall ill before they have satisfied their desires; others, more refined (*κομψότεροι*), are ashamed of showing that they are unwell, and obey the call of their companions; most men hope that the feeling of uneasiness will pass off. But on the morrow they have to confess to catarrh, fever or colic. Then they will beg the doctor to allow them wine or cold water. All such should remember that the unhealthy body feels no pleasure in the indulgences which caused the trouble (127 D—128 E).

The over-strict diet of one who is always afraid of his health giving way is certainly to be blamed, as it renders the body liable to fall sick, while it makes the spirit timid and unenterprising; but it is certainly unwise to wait for those internal pains which are the fore-runners of fever before moderating one's desires and appetites. It is necessary also to be on the watch for bad dreams, crossness of temper and melancholy (128 E—129 C).

When visiting a sick friend enquiry should be made whether it was plethora, heat, exertion, lack of sleep or wrong diet that caused his fever. His answers will serve as a guide. One should care for one's own mode of life, avoiding all excess (129 D—130 C).

Reading and discussion are excellent physical training. The mockery of inn-keepers or muleteers can be neglected (130 C—131 B).

After exercise, cold baths are to be avoided. Those who so indulge fall ill, unless they follow in the smallest details that strict diet which is so undesirable. It is better to oil the body near a fire (131 B—D).

Meat, dried figs and cooked eggs are not desirable; vegetables, fowl and light fish are to be the staple food. Milk as a drink should be avoided, wine in moderation is good, but not as a "pick-me-up" after exposure; water should be drunk several times a day. If it be thought a shame to be deprived of food when a fever is imminent, water may be drunk (131 D—132 F).

While eating, a man should exercise his mind with a book or

conversation. This will make him less attracted by the pleasures of the table (133 A—134 A).

Emetics and purges are bad. Dieting is the proper remedy for indigestion. If something must be done, vomiting is the less evil, but violent drugs must be avoided. Drinking water or fasting for a few days may be tried, or even an injection. Most people take refuge at once in strong purgatives, and suffer for it (134 A—F).

On the other hand, a rigid system of fasting is bad. It is absurd to keep well by ceasing to perform the functions of living. Nay, idleness is not healthy (135 A—136 A).

Toil should not be varied by exhausting pleasures. Love of honourable pursuits will drown any desire that is felt for the latter (136 A—E).

A man should learn all he can about his own constitution, what suits it and what does not. It is important that care be taken not to tax it at the change of the seasons (136 E—137 B).

Students must not tax their bodies by too much study, as the many do by worry and exertion at harvest-time. Otherwise they will be compelled to lay aside their books, while they are recovering from a fever (137 C—E).

It will, I think, be admitted that at the period when the treatise was composed there was much ill-health. The precepts given by the writer himself are strict, and he distinctly states that there were some who imposed upon themselves such rigid rules of life that health was obtained at far too high a cost; for they could not use it without interfering with those prescribed habits which kept them well.* The writer does not seem to be referring to infectious sickness, for he nowhere mentions either contagion or infection.† Indeed, either ancient Greece was singularly free from infectious maladies (other than occasional epidemics) or else the Greeks did not think the danger worth considering. At any rate isolation of the sick, and similar prophylactic measures, were not generally recognised.‡ The great danger, according to Plutarch, was "fever."§ The symptoms of

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* 128 E and 131 C.

† When calling on a sick friend the visitor is not supposed to take any precautions (129 D).

‡ Fumigation by sulphur was known as early as the Homeric period (*Odyssey*, xxii, 481, 493), but the medical writers appear to know nothing of it. Did they regard it as a superstition? Certain skin and eye diseases, with consumption, were regarded as infectious, but not fevers (Aristotle, *Prob.* vii, 8.)

§ Mentioned several times—123 A; 127 B, E; 128 A, F; 129 D; 132 E; 137 D. Once a more specific name, φρενῖτις, is given (124 B).

fever are not described, but a warning is given not to neglect the premonitory signs, and among these are crossness of temper and melancholy.* But the risk of falling ill of fever is said to be greatly increased by certain actions or habits. The "causes" of fever include:—

(1) Violent fatigue (*κόπος*).†

(2) Extremes of temperature,‡ especially chilled extremities and cold baths at unseasonable times.§

(3) Over-indulgence in food and drink.||

(4) Insufficiency of rest and sleep.¶

In addition to these definite dangers, the general tone of the treatise implies a strong recommendation to avoid taxing the body or mind by excess in any form.

Now, with the exception of that prophylaxis which is the direct result of modern discoveries,** this advice is just that which is now given to those who dwell in malarious regions.†† If it be urged that it is unsafe to conclude that malaria is the disease which our writer had in mind, inasmuch as moderation is a good rule under any climatic conditions, the following points should be considered.

Only in a highly malarious country can it be said that fatigue will bring on fever. Of course, fatigue may be the indirect cause of a feverish chill, but it is in malarious countries that the necessity of avoiding over-exertion, and the practical certainty of an attack should this rule be violated, become painfully obvious from repeated experiences. It is also remarkable that such stress is laid on keeping the hands warm. In a non-malarious country cold in the extremities can scarcely be considered a grave danger, but in a malarious region great care must be taken to avoid chill. It should also be noticed that the change of the seasons is regarded as an

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* 129 C.

† 127 B, E; 129 D.

‡ 127 B (*δι' ἐγκαύσεις καὶ διὰ περιψύξεως*); 129 D.

§ 123 A; 126 F; 127 E; Cf. also 131 C.

|| 124 B; 127 C, E; 128 A; 129 D; Cf. also 137 C.

¶ 129 D (*ἀγρυπνίαν*); 137 D.

** E.g., the use of quinine and mosquito-netting.

†† See Celli *Malaria* and Manson *Tropical Diseases* (malaria).

especially dangerous period,* and malaria is most common just before the autumnal equinox. Particular attention should be paid to the difficult passage 137 C,† the general drift of which seems to be that poor country-folk constantly fall ill during their exertions at harvest-time. Indigestion and constipation were evidently common complaints when the writer lived, as he tells us how the people took refuge in violent purgatives.‡ Now although there are many causes of these stomach complaints, derangement of the digestive organs is the invariable accompaniment of malarial cachexia. If any doubt still remains as to the kind of fever which is referred to, the use of *φρενῖτις* § in 124 B should dispel it at once. This word is certainly employed by the medical writers to denote a very pernicious kind of remittent malaria.||

I have tried to prove in the above discussion that the Greeks of the first century A.D., or at any rate some of them, were liable to malarial attacks whenever they put the body to unusual exertions; in other words that the country, or some part of it, was highly malarious. What must have been the consequence to the people at large? What nation can prosper or develop if strain has to be avoided at all costs? How are war, commerce and successful agriculture to be carried on under such conditions? Surely nothing but stagnation is possible. Now the literary evidence shows that malaria was common in Greece during the fifth century, since tertian and quartan fevers are constantly referred to in the Hippocratic writings. But there are only two allusions before 500 B.C. which can point to malaria (*πυρετὸς*¶ in *Iliad* xxii, 31, and *ἠπίαλος* in Theognis 174), and both of these are doubtful. Hesiod never mentions fever among

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* 137 B.

† *ὅσα μὲν γὰρ μικρολογίας καὶ ἀνελευθερίας προσκρούσματα λαμβάνουσιν οἱ πολλοὶ περί τε συγκομιδὰς καρπῶν καὶ τηρήσεις ἐπιπόνους, ἀγρυπνίαις καὶ περιδρομαῖς ἐξελέγχοντες τὰ σαθρὰ καὶ ὕπουλα τοῦ σώματος, οὐκ ἄξιόν ἐστι δεδιέναι μὴ πάθωσιν ἄνδρες φιλόλογοι καὶ πολιτικοί.*

‡ *φαρμακείας, ἐφ' ἃς οἱ πολλοὶ φέρονται προχείρως* (134 F).

§ For *φρενῖτις* see Hippocrates, Kühn II, 27, 28, 299, 300, 387.

|| See Littré's *Hippocrates*, Vol. II.

¶ The word *πυρετὸς* does not occur again till the second half of the fifth century B.C. In Homer it was said by some ancient commentators to mean "heat." Why did they not assume the meaning to be fever? Surely this points to a tradition that malaria did not exist in Homer's time.

the plagues of the Boeotian farmer, but Plutarch, a native of Boeotia, has a different tale to tell. There can, I think, be no doubt that malaria was rapidly on the increase§ from the fifth century B.C., and that it was largely responsible for the lack of energy that the Greeks began to exhibit during the fourth century.

Plutarch noticed that the feverish attack is often preceded by melancholy and crossness of temper,* two most noticeable symptoms of malaria. The physician Hippocrates went much further. After carefully describing what regions are most malarious, he goes on to say that the inhabitants of such regions are stunted in growth, and have neither courage nor powers of endurance.† Plato declared that ill-health (the symptoms point to malaria as much as anything else) produces crossness, melancholy, rashness, cowardice, forgetfulness and stupidity.‡ Surely it is reasonable to conclude, not only that malaria produced disastrous changes in the Greek character, but also that the great thinkers among the Greeks were perfectly conscious that it did. Plato would have introduced remedial measures,‖ but, of course, his advice was not taken, and Greece gradually fell into the unhealthy state which is manifest in the pages of the treatise *de sanitate tuenda*.

§ The words **πυρετός, πυρέσσω,** become more common, and are regularly used in non-medical works to mean intermittent (i.e. malarial) fevers. See Demosthenes, 118, 20.

* 129 C.

† *Airs, Waters, Places*, Kühn I, 566, 567.

‡ *Timaeus* 87 A.

‖ Namely, careful nurture and good institutions (*Timaeus* 87 B.). This reminds one of the remark of Hippocrates (*loc. cit.*) that **νόμος** might restore the moral fibre of malarious peoples, and good drainage bring back their health. For Plato's later views on vice see Gomperz, *Greek Thinkers*, Vol. III, 225, 226.

# TWO NEW HUMAN CESTODES AND A NEW LINGUATULID

# TWO NEW HUMAN CESTODES AND A NEW LINGUATULID

BY

J. W. W. STEPHENS, M.D. CANTAB., D.P.H.

(WALTER MYERS FELLOW IN TROPICAL MEDICINE, THE UNIVERSITY OF LIVERPOOL)

*(Received for publication December 20th, 1907)*

## I. A NEW BOTHRIOCEPHALID IN MAN

(*Dibothriocephalus parvus* n. sp.)

Three pieces of a tape-worm, none of which had a head, were received by me from Dr. Elkington, Tasmania, in 1906, with the following history: 'It came from a Syrian, not long arrived from his native country, and aged 37. It was caught on December 20th, 1898, at Launceston, with the aid of *Filix mas.* A quantity had already come away before he came under treatment. So it is possibly a Levantine product after all, and not Australian in origin. He is supposed to have come from Beyrout, but this is not certain.'

A superficial examination shewed that the tapeworm had all the appearance of a *Dibothriocephalus.* The proglottids had a clearly defined central uterine rosette, and with a lens the openings of the cirrus and uterus could be seen, and in several segments the cirrus was extruded. The surface of many of the segments was much corrugated with transverse and longitudinal furrows (probably due partly to the preservative and partly to erosion (digestion) of the surface.

The strobila consisted of three portions, the lengths of which were respectively 1025, 940 and 690 mm. In the portion, 1025 mm. long, there were 420 proglottids, usually broader than long. The smallest anterior proglottids measure 1·3 mm. broad by 0·6 mm. long. The largest posterior proglottids measure 5·0 mm. broad by 3·0 mm. long. The terminal segments tend to become quadrate and measure 4·0 by 4·0. Several segments approximately quadrate are, however, interpolated irregularly so that the gradual decrease in breadth and

increase in length from one end of the worm to the other is broken at intervals and is not uniform as in *D. latus*, &c. As stated above the dimensions of the largest gravid segments are 5 by 3 mm. The uterus forms a central rosette with four to five loops on each side of the median line, occupying about the middle half of the length.

In a proglottid measuring 3·5 by 2·25 the genital atrium is situated 0·4-0·5 mm. behind the anterior margin, and the uterine opening is situated the same distance behind the genital atrium.

The eggs, operculated, average 59·2 by 40·7 $\mu$. Calcareous corpuscles were absent in those segments examined.

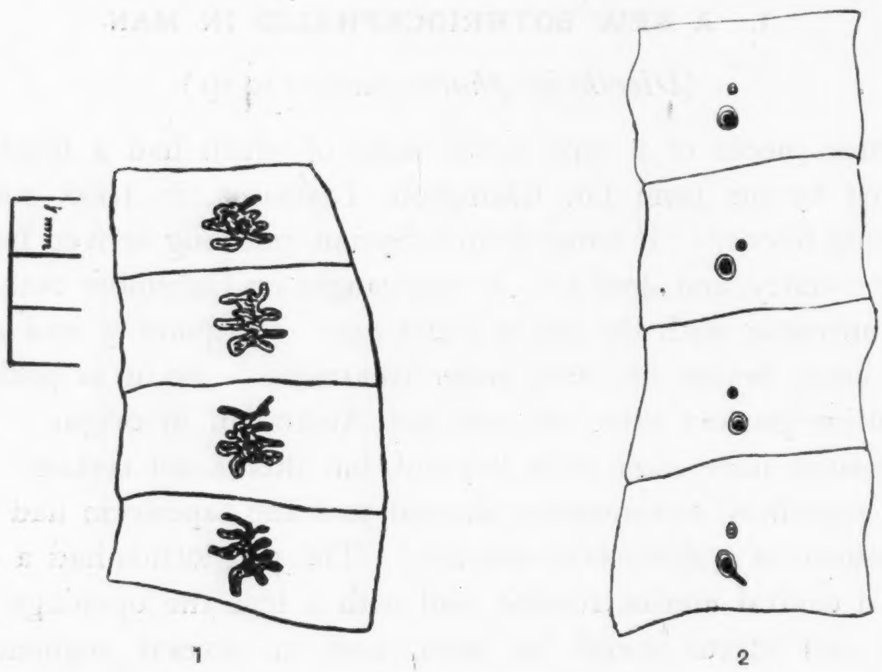


FIG. 1. *Dibothriocephalus parvus*

(1) Outline of uterine rosette
(2) Genital atrium, uterine pore and protruded cirrus

The question now arises as to the identity of this worm.

(*a*) On comparing it with *D. latus* we see that the maximum width of gravid segments is 5 mm., while the minimum width of gravid segments of *D. latus* is 10-12 mm., and the maximum width 20 mm., so that the worm is a very much smaller one, as is evident to the naked eye. This is also shewn by the size of the quadrate segments which in *D. latus* are 6 by 6 mm., while in *D. parvus* they are 4 by 4 mm., and moreover the quadrate segments in *D. latus*

occur posterior to segments which attain a width of 15 mm., while in *D. parvus* they occur after segments, the maximum width of which is only 8 mm., and in the case of the interpolated segments, after segments which are still narrower.

(*b*) The whole strobila appears always to be distinctly thicker than *D. latus*, a point which is especially noticeable along the lateral margins.

(*c*) Secondly there is no indication of the serration due to the projection of the posterior lateral angles, a feature well marked in *D. latus*.

(*d*) The eggs of *D. parvus* (59·2 by 40·7$\mu$) are smaller and rounder than those of *D. latus* (68-71 by 44-45$\mu$).

(*e*) Calcareous bodies are absent in *D. parvus*, while they are present (few) in *D. latus*.

(*a*) On comparing with *D. cordatus*, we find that this has only 50 immature segments while in one of the pieces of *D. parvus* there were at least 200 segments before maturity.

(*b*) The mature segments of *D. cordatus* are 7-8 mm., the maximum width of *D. parvus* is 5 mm.

(*c*) The quadrate segments of *D. cordatus* measure 5-6 mm. square. Those of *D. parvus* 4 by 4 mm.

(*d*) The uterine loops of *D. cordatus* are 6-8. Those of *D. parvus* 4-5.

(*e*) Eggs. *D. cordatus* 75-80 by 50. *D. parvus* 59·2 by 40·7$\mu$.

(*f*) Calcareous bodies. *D. cordatus*, 28-30, numerous. *D. parvus*, absent.

The characters of this bothriocephalid seem to me to be sufficiently distinct to warrant the making of it a new species. I propose the name *Dibothriocephalus parvus*. The type species is deposited in the museum of the Liverpool School of Tropical Medicine.

## II. A NEW HUMAN CESTODE

(*Taenia bremneri*, n. sp)

In July, 1907, I received from Dr. Bremner, Nafada, Northern Nigeria, about half a dozen segments of a tape worm passed by a Fullani woman. The patient stated "that *all* Fullani women have them, and that they are got through drinking sour milk."

The most striking feature of the proglottids was their size, being greater in length, and especially in breadth, than that of any human *Taenia* so far described. The measurements were as follows:—

Maximum, 32 × 9 mm.
Average, 28·6 × 8·5 mm.
Commonest, 29 × 10 mm.
Smallest, 21 × 6 mm.

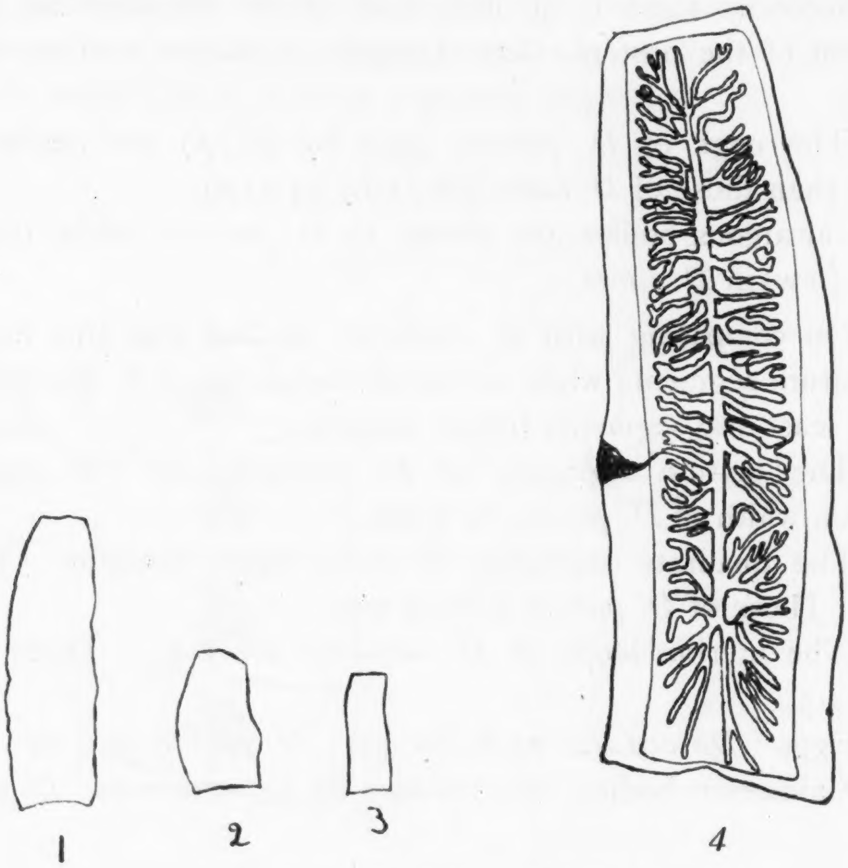


FIG. 2. *Taenia bremneri, n. sp.*

Gravid segments of (1) *T. bremneri*, (2) *T. saginata*, (3) *T. solium*, (4) Uterine branches enlarged nearly four times

On clearing a specimen, the uterine segments were in some segments 22 to 24 in number, not counting the "terminal" one which curves forward and has four or five branches on it. The figure shows the arrangement of the uterus. The genital pore is prominent and lies behind the middle of the segment.

Eggs: Minimum, 34·2 × 30·4.
Commonest, 38 × 30·4.
Maximum, 45·6 × 41·8.

Calcareous bodies are numerous, measuring 15·2$\mu$ in diameter. This species is distinguished from some of the species found in man by the following points:—

*T. africana*.—Segments always broader than long.

*T. confusa*.—The gravid segments may be as long as 35 mm., but the width is only 5 mm., whereas in the present species, with a length of 32 mm. the width is 9 mm.

*T. saginata*.—Gravid segments, 15 to 20, rarely 25 mm. long, 4 to 7 mm. wide.

*T. solium*.—Gravid segments, 10-12 long by 5 mm. broad.

I hope soon to be in a position to describe complete specimens of this worm; for the present I propose the name *Taenia bremneri*.

The type segments are in the museum of the Liverpool School of Tropical Medicine.

## III. A NEW LINGUATULID

(*Porocephalus pattoni, n. sp.*)

*Habitat*:—This linguatulid occurs in the lungs of the Indian rat snake *Zamenis* v. *Ptyas mucosus* or Dhaman.

*Diagnosis*:—Body greyish white (spirit specimens), showing a separation into head, neck and body. The head is globular and flattened ventrally and rounded dorsally, and is separated from the body by a fairly distinct narrow portion or neck. Of some dozen


FIG. 3. *Porocephalus pattoni*
(1) Hook, (2) mouth, (3) egg

specimens measured the longest was 11·5 centimetres, while the shortest was 2·5 centimetres. The majority were between 6 and 8 centimetres. The number of rings varies somewhat, but an average size specimen has 36. There are generally two rings on the head. The body is cylindrical, ends bluntly, and the posterior end exhibits some tortion. The thickness of the body is about 2·5 mm. On the

ventral surface of the head are two pairs of strongly curved hooks similar in appearance to those in many other Linguatulids, e.g. *Porocephalus annulatus*, and the details also of the hooks resemble those of other Linguatulids as far as can be judged from figures, though no measurements usually accompany these. In fig. 3 is seen an isolated hook with its appendages. They bear a general resemblance, for instance, to those of *P. teretiusculus*. Between the hooks lies the chitinous opening of the mouth. This has the shape of a horse-collar, resembling the mouth of *P. annulatus*. In front of the hooks and mouth are several small papillae corresponding in position to the continuation of the clefts that contain the hooks. I was unable to detect papillae in any other situation. The cutaneous pores are abundant on the head and anterior rings; they then become indistinct, but some are visible on the last segments. The eggs taken out of the uterus measure about $80 \times 70\ \mu$ (fig. 3).

As far as I am able to judge from the literature of the subject this species is a new one. I propose provisionally the name *Porocephalus pattoni* in honour of Capt. Patton, I.M.S., who was kind enough to send me the specimens.

The type specimens are in the museum of the Liverpool School of Tropical Medicine.

## Addenda et Corrigenda

Page 43. *Chrysops dimidiatus*, v. d. Wulp.

The specimens recorded from Banana* are of this species. Those from the other localities are all *Chrysops silacea*, Austen (Ann. and Mag. Nat. Hist., ser. 7, Vol. XX, p. 509, 1907). On comparing the examples of *Chrysops* from the Congo Free State with Austen's description of *C. silacea* I came to the conclusion that we had examples of both *C. dimidiatus* and *C. silacea*. Mr. Austen, who has kindly examined a specimen of the former, says that I am "perfectly right" in my identification; the footnote by Mr. Austen (l. c., p. 512) should, therefore, be amended so as to include only those specimens which were taken by Dr. Ettiene at Banana.

ROBT. NEWSTEAD.

* The package containing these specimens, was dated 'Oct. 22, 1902.'

## EXPLANATION OF PLATE L

Fig. 1.—*Dibothriocephalus parvus, n. sp.* Portion of strobila, actual size.

Fig. 2.—*Porocephalus pattoni, n. sp.* The Linguatulids *in situ* in the lung of *Zamenis mucosus.*

Fig. 3.—*Porocephalus pattoni, n. sp.* Actual size.

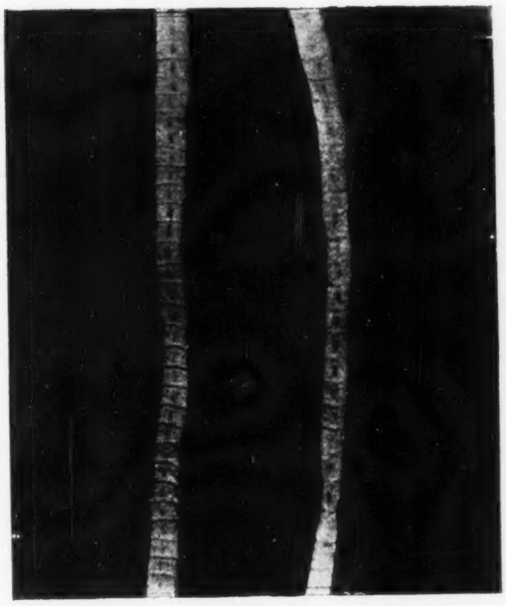

Fig. 1

Fig. 3

Fig. 2

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